DISSERTATION

HOLDING ON TO THE GOOD LIFE: SAMBURU WOMEN'S RESILIENCE AND RESPONSE TO CLIMATE CHANGE

Submitted by

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ABSTRACT

HOLDING ON TO THE GOOD LIFE: SAMBURU WOMEN'S RESILIENCE AND RESPONSE TO CLIMATE CHANGE

This dissertation seeks to explore climate change resilience from the perspective of pastoral women in Samburu, Kenya. It investigates the resilience-related concepts of adaptive capacity, response strategies, and well-being. In Northern Kenya, the increasing frequency of drought is forcing pastoralists to respond to a changing climate while a variety of socio-economic changes simultaneously both constrain and enhance their ability to respond. Pastoral women sit at the very nexus of these shifting dynamics; women continue to face significant barriers that limit their adaptive capacity, are often responsible for the increased workload associated with a changing climate, and experience unique and gendered impacts of engaging in climate change response strategies.

The first manuscript in this dissertation applies a dimensional framework of well-being to the experiences and perspectives of Samburu women. We use semi-structured interviews and a novel participatory activity entitled "Build Your Best Life" to explore what it means for Samburu women to "have a good life." A well-being framework created by the ESRC Research Group on Well-Being in Developing Countries guides our presentation of twelve themes organized into three unique dimensions. Further, we argue for the importance of taking into account how different components of well-being influence each other and the implications of these interactions for climate resilience interventions.

The second manuscript uses a participatory adaptation scenario and mapping activity to explore how formal education -- a common foundation of adaptive capacity -- influences Samburu women's livestock-related decision-making processes as they respond to drought. This manuscript builds on Cinner et al.'s (2018) framework of adaptive capacity and suggests that in order to leverage the potential of formal education to positively impact adaptive capacity, education must influence both the learning and agency components of adaptive capacity.

Finally, the third manuscript investigates the influence of various response strategies on women's well-being and household livestock loss. We differentiate between coping and adaptation strategies and use the well-being framework from the first manuscript to look at how coping and adaptation uniquely impact women's sense of being able to provide for their children and their hope for the future. We use the gendered divisions of labour associated with drought adaptation and coping strategies to explain our results. As a whole, this dissertation attempts to understand how Samburu women are experiencing drought, the barriers they face in responding to drought, the response strategies they engage in, and how those responses may impact their well-being. Our results underscore the importance of using a gendered lens to understand climate resilience and creating culturally relevant frameworks for resilience-related concepts. We subsequently discuss implications for theory and practice.

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It is a humbling experience to come to the end of a journey as lengthy as the PhD process and reflect on all the people who have made it possible. To my committee, I cannot begin to express my gratitude for your enduring support. Brett, thank you for showing me what it means to conduct research that centers people's well-being and for bringing me into your Archer's Post family. To Jill, Jen and Kim - your advice and unwavering support have meant the world to me.

To my family and friends - every step of this journey has been possible because of you all. You continuously push me to ensure the work I do matters; that it prioritizes making the world a better place. To my mom, grandmothers, and aunts - thanks for being strong women who encouraged me to go after what I wanted.

To my Samburu team - Apin, Elizabeth, Anna, Rosa, Damaris, Antonellah, Christine, Veronica, to all the women of Unity village: the pages that follow are yours. They are a product of your ideas, your opinions, your labour and our friendship. Thanks for letting this '*mzungu*' be a part of your life.

To the women of the Archer's Post community - there are no words to even begin to communicate my enduring appreciation for your generosity, friendship, and constant reminders of what really matters. You invited me into your community, families, and homes with open arms, constantly answered my questions, and were never shy to remind me of what I did not know. Your kindness and strength will always be my greatest teacher. *Ashe Oleng.*

Finally, to my partner, Alex - without you, none of this would have been possible. You travelled halfway around the world with me and shared the adventure of a lifetime. You are and

will always be my greatest strength. This dissertation has been a labour of love, one that was only made possible by your love.

Note on authorship

While my name is the sole name on this dissertation (as required by the graduate school), this dissertation is a product of a collaborative process. As a result, I frequently use the term 'we' in the following pages to highlight the collaborative nature of our work. The many co-authors are listed in the peer-reviewed publications from this dissertation and include the following: Chapter two is coauthored by Brett Bruyere, Apin Yasin, Elizabeth Lenaiyasa, and Anna Lolemu. Chapter three is coauthored by Brett Bruyere, Jill Zarestky, Apin Yasin, Elizabeth Lenaiyasa, Anna Lolemu, and Tomas Pickering. Finally, chapter four is coauthored by Brett Bruyere, Jennifer Solomon, Apin Yasin, Elizabeth Lenaiyasa, Anna Lolemu, and Kathryn Powlen.

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CHAPTER 1: INTRODUCTION

Positionality statement

In my research, I draw on paradigms of constructivism and critical theory (Glesne, 2016; Schwandt, 2014); believing that all knowledge is socially constructed, and issues of power and equity inform this construction. Understanding how my identities, experiences, and surroundings impact my research is a critical component of conducting "good" research. The intention behind this positionality statement is to interrogate how some of these identities have impacted the work described in the following pages.

I am a white woman in my late twenties. I am a Canadian living in the United States. I was raised in a rural community, in a middle-class family that relied heavily on agriculture and small business for our livelihood. I was raised in the Catholic church, but no longer identify as a member of the Christian community. I hold what many would consider 'progressive' political views. I also believe that research and advocacy go hand in hand. And while it's critical that researchers are transparent about their beliefs and values as they advocate, the ultimate purpose of conducting research should be to help make the world a more equitable, just, and better place.

All of these identities and values impact my research in various ways, some more strongly than others. Working in Kenya as a white woman, I am automatically an outsider but often hold a position of power. Conservation in Kenya has a long history of colonialism, as the conservation sector has been largely dominated by white, European leadership. While the growing popularity of small, community-based initiatives are changing the landscape of conservation in Kenya, the legacy effects of this history carry with me every time I enter a room. I can easily reinforce these inequitable racial dynamics, and power differentials. Nearly every interaction I have will be impacted by these dynamics.

My identity as a woman drives my interest in gender work. When conducting research in Samburu, my gender has opened many doors, both literally and figuratively that are often closed to my male colleagues of various nationalities and races. Gender is a critical aspect of the construction of Samburu society; my gender identity has allowed me to build relationships and begin to understand the experiences of Samburu women in a manner largely inaccessible to my male colleagues. However, my gender makes it unlikely that I will ever have an 'unguarded' and what feels to me like an 'authentic' relationship with a Samburu male elder.

In addition to my race and gender, my Western world view also impacts how I show up in Samburu and my research. I have to put in significant work and reflection to understand and appreciate the role that gender roles play in Samburu society, as my Western lens on issues of equity and justice is highly dependent on the idea that distribution of opportunities and responsibilities based on gender is inherently bad. This contradicts the prioritization of rights over responsibilities, common in many collectivist Indigenous cultures. Sorting out how to investigate gender roles simultaneously from a perspective of cultural relativism and a framework of women's rights is something with which I constantly battle.

Another way my 'Western' world view shows up in my work, is via the Western conservation ethic, particularly within the scope of academia which often posits human well-ecological health as mutually exclusive. This hinders my ability to truly use a systems perspective, as I am constantly thinking about the tensions between the ecological and social components of any system, rather than seeing the system as a whole. This influences the questions I ask, the way I phrase these ideas and concepts with local stakeholders and how I frame or see data.

Beyond these identities, my life experiences play an important role in why and how I conduct research. Growing up in a rural community, largely reliant on agriculture, has been one of the most salient ways in which I have felt connected to pastoral communities. More specifically, my experience growing up in a rural farming community has rooted in me an internal value for nature and biodiversity; but I also inherently prioritize livelihoods and human well-being. I can easily relate to communities attempting to navigate conservation ethics and the need to provide for their families all while society often puts these two ideals at odds with one another.

My race, gender, Western perspective, and upbringing are all critical parts of my identity. However, it is the process of understanding and unpacking my race and associated privilege that I believe most significantly impacts my work and my relationships with the Archer's Post community. I am a white woman who is still learning to process, understand, and act on the implications of my white identity and privilege. Sometimes, I find myself in moments where I am hyper aware of my skin color and the privilege it comes with, paralyzed and unsure of how to engage. In other moments, this hyper awareness has increased my confidence in building authentic relationships with Samburu women, pushing me to directly address the differences in our identities in appropriate and effective ways. I can flip between these two vastly different states in a matter of seconds. Sometimes I navigate race-related power dynamics with something that might resemble aptitude; other times, I fail miserably. I am far from finished with my journey of investigating my own relationship with race and privilege; but I do believe the process thus far has helped me to become more reflexive and ethical in my practice. I hope that my work, outlined in the following pages, highlights my critical engagement in this process. Practices such as focusing my research on questions relevant to the community, relying on a

research team consisting primarily of local Samburu women, and using methods that position participants as experts and prioritized their engagement are all examples of how I attempted to stay accountable to and mitigate potential impacts of my identities. This statement does not signal the end of my engagement with these issues but rather a lifelong commitment.

Climate change, resilience, adaptation: Conceptual frameworks

Climate change is predicted to have significant negative effects on communities all around the world (Field, 2014). Some of these impacts are already occurring; increase in frequency and intensity of natural disasters such as drought, floods, storms, and fires are negatively impacting communities and the ecosystems in which they live (Field, 2014). Communities where livelihoods are heavily reliant on natural resources are the most vulnerable to these impacts and often have the least access to the necessary resources to respond (Adger et al., 2003). At the same time, these communities are frequently the least responsible for the anthropogenic drivers of increased CO_2 concentrations in the atmosphere (Althor et al., 2016). While there remains some optimism in the international community's ability to come to multilateral agreements that will reduce future impacts (Bodansky, 2016; Glanemann, 2020), climate change impacts are inevitable and will continue to occur (Whyte, 2019; Jewell & Cherp, 2020). Consequently, improving and supporting the climate resilience of communities is critical for ensuring human well-being and ecosystem viability.

In this dissertation I explore the different aspects of climate resilience from the perspective of pastoral women in the semi-arid rangelands of Northern Kenya. My theoretical understanding of this issue relies heavily on social-ecological systems (SES) literature, which contends that SES resilience is the capacity of a system to tolerate disturbance without collapsing into a qualitatively different state (adapted from Gunder, 2000; Holling, 1973; Adger 2000;

Berkes & Folke, 1998). Resilience provides a multi-scale, process-oriented framework for understanding how SES systems react to disturbances such as climate change. More specifically, my work focuses on several, tangible concepts associated with the process of resilience, including adaptive capacity, response strategies, and well-being. Below I outline my understanding of each of these terms, and how they interact with one another to build my conceptual framework of resilience.

Well-being

Well-being is a foundational concept within this dissertation. I utilize the following well-being definition: *a state of being with others and the natural environment that arises where human needs are met, where individuals and groups can act meaningfully to pursue their goals, and where they are satisfied with their way of life*" (Armitage et al., 2012; adapted from McGregor, 2008). I theorize that the pursuit of and maintenance of well-being is the ultimate driver of decision-making for human beings, including when they respond to climate change disturbances. While many components of well-being may be generalizable, the ways in which well-being materializes and is experienced is specific to culture, place, and socially constructed identities such as gender. Chapter 2 of this dissertation contributes to building a culturally relevant framework for understanding well-being from the perspective of pastoral Samburu women. Chapter 4 also uses the concept of well-being, to investigate the influence of different drought response strategies on the well-being of Samburu women.

While a variety of literature underscores the critical relationship between well-being and SES resilience (Béné et al., 2012; Woodhouse et al., 2015), my subjective bias in homing in on this concept should be acknowledged. My undergraduate degree is in psychology, with a focus on positive-psychology. Understanding human nature from the lens of psychological resilience -

the fight to achieve and maintain well-being - has always fascinated me. While working as a crisis counselor, I was frequently inspired as I watched students rely on their resilience in their struggle to find well-being. When I started to think about resilience from an environmental and SES lens, I couldn't ignore my fascination with well-being and the strengths I believed it could bring to resilience theory

Adaptive capacity

In addition to well-being, the concept of adaptive capacity is a theoretical building block of my research. My work contends adaptive capacity, the capacity of an actor to respond to disturbance, is largely a function of the resources to which one has access, and their ability to leverage such resources (Adger et al., 2003; Andrijevic et al., 2020; Brooks et al., 2005; Cinner et al., 2018). Cinner et al.'s (2018) work brings clarity to the "ability to leverage" aspect of adaptive capacity with their holistic conceptual framework. Their framework posits adaptive capacity consists of five domains: (1) the *assets* that individuals can rely on (2) the *flexibilit*y to utilize different adaptation strategies; (3) the ability to collectively *organize* and act ; (4) *learning* how to understand and react to a changing system; and (5) the *agency* to act or not. There are many different definitions and frameworks for thinking about adaptive capacity (Armitage, 2005; Siders, 2019), but I have found Cinner et al's (2018) work to be the most tangible and easily applied. Consequently, I rely heavily on their framework in chapter three to understand how formal education experience may influence how women make livestock-related decisions in response to drought.

Response strategies

The term adaptation is frequently used as a 'catch all' term for changes people make in response to environmental disturbances, but the term has various definitions and has been used at

multiple scales (Adger et al., 2003; Nelson et al., 2007; Smit & Wandel, 2006). To avoid some of this confusion, I have chosen to use the terminology of 'response strategies', to refer to the way in which actors respond to climate change disturbance and rely on literature that differentiates these response strategies as eithers coping or adaptation strategies (Alemayehu & Bewket, 2017; Erikson & Kelly, 2007; Azumah et al., 2017). Coping strategies can be defined as temporary adjustments that tend to be reactive and aimed at restoring or maintaining a previous state (Opiyo et al. 2015; Erikson & Kelly, 2007; Venkatasubramaniam & Ramnarain, 2018). Adaptation strategies, on the other hand, are long-term proactive adjustments to current and future stressors (Opiyo et al. 2015; Erikson & Kelly, 2007; Venkatasubramaniam & Ramnarain, 2018; Nelson et al., 2007). Morton (2007) stresses the distinct difference between coping and adaptation: adaptation strategies reduce overall vulnerability to climate shocks while coping strategies manage and reduce the impact of already occurring shocks. The differentiation between these types of strategies is discussed in greater detail in chapter four of my dissertation as I attempt to understand how these types of strategies influence Samburu women's well-being.

Figure 1. illustrates how I integrate the concepts of adaptive capacity, response strategies and well-being to create a conceptual framework for understanding climate resilience. My framework posits that climate resilience is a process in which an actor is impacted (in actuality or perceived future impact) by a disturbance. They then respond to that disturbance, and their response is determined both by the adaptive capacity and response strategies (coping and adaptation) available to them. Ultimately, the point of this response is to mitigate the negative impacts (or take advantage of opportunities) of the disturbance in an effort to maintain or achieve well-being. Most importantly, how an actor within a SES system experiences well-being, the adaptive capacity an actor has, and the response strategies available to them, are driven by

interactions between climatic and non-climatic factors and are specific to the socially constructed identities that individual actors hold.

In the context of this dissertation, the climate change disturbance is drought, the specific actors within the system are Samburu women, the adaptive capacities are specific to the lived experiences of Samburu women, and the response strategies available are specific to pastoral livelihoods in the semi-arid rangelands of northern Kenya.

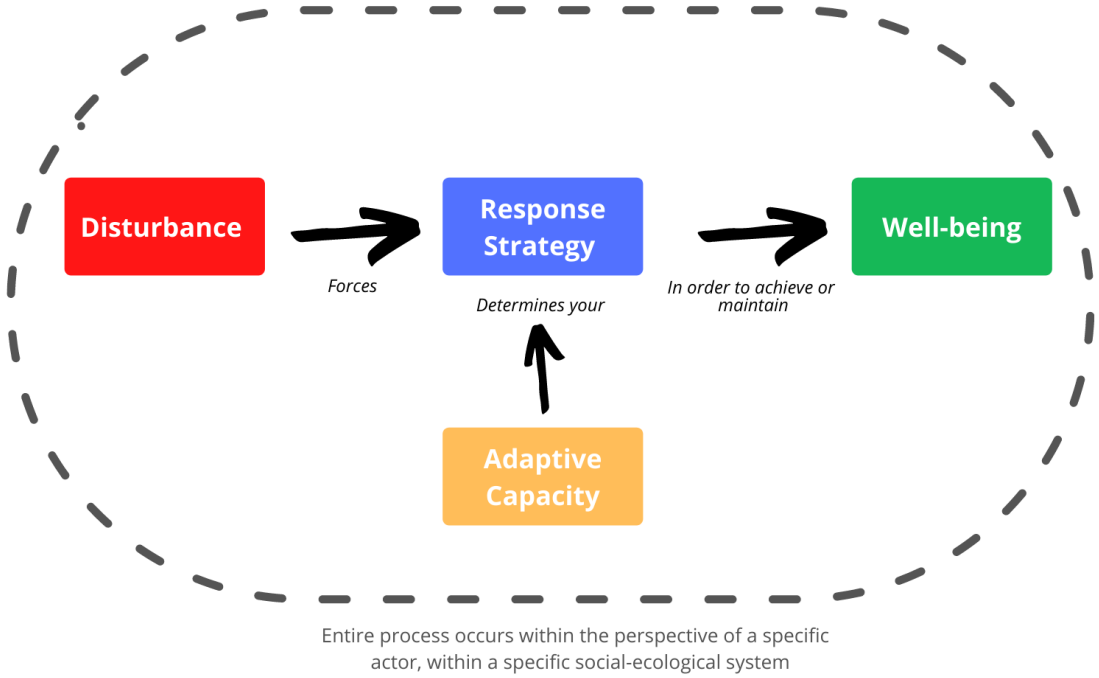

Figure 1. Conceptual framework of climate resilience.

Pastoralism

Arid and semi-arid landscapes (ASAL) cover more than 43% of Sub-Saharan Africa's terrestrial landscape and supports an estimated 268 million pastoralists (Anderson et al., 2004). Pastoralism is a livelihood strategy dependent on the raising of livestock (Dyson-Hudson, 1980) and most pastoral communities traditionally practice transhumance or nomadism, migrating across the landscape in search of water and forage (Kratli et al, 2013). Due to the harsh

conditions limiting the potential for significant crop production in ASALs, pastoralism is thought to be the most efficient and sustainable livelihood in these landscapes (Kratili et al., 2013, Homewood, 2008).

However, ASALs and the communities situated within them, such as those in Northern Kenya, are significantly affected by climate change via increasing frequency of drought and decreased predictability of precipitation (Morton 2007; Conway et al., 2019; Zaroug et al., 2019), which influences the availability and productivity of rangelands. Drought is not a new phenomenon for pastoralists, but the increasing frequency of drought in combination with other social, economic, and ecological drivers, limits pastoralists' ability to respond to increasing climate variability. Most notably are issues of land privatization, insecurity, and anti-pastoral government policies; all of which undermine pastoral rights to graze and increase sedentarization (Goldman & Riosmena, 2013; Behnke, 2020; Dabasso et al., 2019). These constraints on pastoral mobility have resulted in increased livestock disease and mortality, out-migration to urban centers, increased dependency on food relief, and intensified environmental degradation (Morton, 2007; Liao et al, 2020). Consequently, understanding the diversity of strategies pastoralists use to respond to drought, their ability to engage in these strategies, and the resulting impacts, is critical for supporting pastoral communities as they work to maintain or achieve well-being in the face of climate change.

Samburu people of Waso East

The Samburu people make up approximately 0.06 % of Kenya's total population and reside in Samburu County (see Figure 2). The Samburu are one of over 40 tribes in Kenya, and by population, one of the smallest tribes in the country (Kenya National Bureau of Statistics, 2019). With respect to national leadership, Kenya's politics rely to some extent on tribal

affiliation, which bleeds over into policy making and resource allocation (Shilaho, 2017). As a result, the Samburu in addition to other pastoral tribes in Kenya, have been historically marginalized by state-decision makers and their policies (Jordt Jørgensen, 2013; Pavanello, 2009).

The research for my dissertation was conducted in the Waso East district, more specifically, in the greater community of Archer's Post, approximately 300 kilometers north of the capital city, Nairobi. The region is characterized by temperatures typically ranging between 18 to 30 degrees Celsius and an average annual rainfall of 350 mm (Pas, 2018; Wittemyer, 2011). Recent increases in drought frequency in the region is thought to be attributable to climate change (Opiyo et al., 2015; Ouma et al., 2018).

In addition to the Samburu people, the region is home to several endemic, vulnerable or endangered species such as the Grevy's zebra (*Equus* grevyi), reticulated giraffe (*Giraffa camelopardalis* reticulata) and Beisa oryx (*Oryx* beisa). Due to the high biodiversity and pressures on rangelands, several protected areas are located in the region, from government-run national reserves to locally governed community conservancies. The area also hosts several

Figure 2. Map of Kenya, Samburu County highlighted in grey.

conservation and development organizations, ranging from small, locally run groups to large, international organizations.

Specifics of participants and the social structure of Samburu culture (such as how gender and age impact the lived experience of Samburu people) are discussed in greater detail in the methods section of Chapters 2 through 4. Broadly, participants in my research were all Samburu women, who resided within an approximate 15 kilometer range of Archer's Post town between June and December of 2019. A majority of participants belonged to households actively engaged in pastoralism as a livelihood, although some level of livelihood diversification was common for most households. Our studies included both women in traditionally male-headed households and single mothers, and participants represented a variety of ages, ranging from approximately 18 to 80 years of age.

A gendered analysis without a gendered comparison

The purpose of my dissertation research was to investigate concepts related to climate resilience from the perspective of Samburu women. Adger et. al (2003) argued that responses to climate variability are "embedded in the social processes that reflect the relationship between individuals, their networks, capabilities, social capital, and the state" (pp. 186). Constructivist and critical epistemologies recognize gender as one of these social processes that fundamentally impact an individual's experience of the world (Schwandt, 2015).

A variety of literature focused on climate change in pastoral landscapes evidences the influence gender has on people's experience and response to drought. Pastoral women face "double marginalization" due to the intersection of their identities as women and pastoralists. This marginalization influences their vulnerability to climate change, capacity to respond, and the impacts of those responses (Eneyew & Mengistu, 2013; Balehey et al., 2018, Ongora &

Ogara, 2012). More specifically, gendered marginalization limits pastoral women's ability to own land and livestock, access formal education, and acquire non-pastoral employment, all of which increase an individual's capacity to cope or adapt to climate stressors (Gurmu, 2018). Furthermore, women's limited access to these opportunities is intensified by the increase in "women's work" driven by climate shocks. Tasks such as collecting water and firewood, taking care of sick livestock, and herding small livestock become increasingly labour intensive during a drought (Gurmu et al., 2013; Westervelt., 2018).

Many studies that use a gendered lens to investigate livelihood responses to disturbances such as climate change compare the experiences of men and women (Abdul Razek & Kruse, 2017; Aregu et al., 2016; Balhey et al., 2018). While this is a valuable and necessary approach to understanding how gender influences experience with climate change, there are two key strengths of narrowing the scope of our study to the experiences of women. First, a valid comparison of gendered experiences would require a study design that engages with people of different genders in the same way. However, in a society so structured by gender roles, the methodology used to engage with participants may need to be specific to participants' gender. In Samburu, the appropriateness of specific topics, the time of day to engage with participants, the identities of the facilitator, the group size, and the age range of participants, all differ by gender. As a result, my team decided that in order to conduct research in a way that recognized and respected the cultural nuance of gender in Samburu, we needed to keep our study scope specific to the experiences of women.

Second, cross-cultural research conducted by foreigners in communities in the Global South has a long history of reinforcing patriarchal hierarchies as early research often only focused on the experiences of men in communities like Samuru (Spencer, 1970; Galaty, 1982).

As the scope of scholarship moved beyond this, studies started to include women's experiences, but largely as a comparison group for men. Seminal feminist works such as Harding's Stand Point Theory (2009) and Sprague's work on critical feminist methodologies (2016) argue for scholars to conduct their research from the perspective of the marginalized inherently, recognizing the 'stand-alone' value of this type of knowledge creation. The goal of our research was not to further position the validity of women's experience as a comparison to men, but rather to highlight the theoretical and applied value of women's experiences as stand-alone viewpoints.

Methodological Approaches

As a researcher with grounding in constructivist and critical epistemologies, I believe post-positivist methods aimed at prediction have significant limitations. While such methods have value in some scenarios, they are most appropriate when being used in combination with other methods to tell a more complex narrative. I also recognize the long history of research conducted by Western foreigners in developing countries. In places like Samburu, this history has resulted in a significant number of studies being conducted with limited relevance to community needs, minimal dissemination of results to community members, and extractive methods (Van Anda et al., in review *b*). Out of respect for these histories and my epistemological groundings, I sought to conduct research that could be useful to the community and local organizations, provide benefits to participant for simply engaging in the research, minimize power dynamics as much as possible, was culturally appropriate and relevant, and frankly, was fun to participate in and conduct.

From May to July of 2018, our team spent time interviewing community members, leaders, and organizations to identify research topics and questions that would be relevant and fill a need. Drought resilience and women's well-being emerged as critical topics. From May to

December of 2019, we collected the data for this dissertation. Our research team consisted of seven Samburu research assistants who have been engaged, to various degrees, in all phases of our research process. We also formed an advisory board of local women leaders to help guide our methods and engagement with the community. We received ethics approval from both Colorado State University's institutional review board and the permission of local elders from each of the villages in which we worked. Our most participatory and innovative methods are documented in chapters two and three, and the results from both chapters inform our more quantitative household survey in chapter four.

We are committed to ensuring the results of this study are shared with community stakeholders in the community. This critical aspect of conducting ethical community-based research (Walker et al., 2020; David Chavez et al., 2017) and increases the potential for this work to have real world implications. We are currently working to summarize the results of this research into accessible, digestible reports for local NGO's and government agencies. Initial results were disseminated in December of 2019 with participants, and once travel to Kenya is safe and possible, we intend to continue in-person dissemination with community stakeholders.

CHAPTER 2: THE GOOD LIFE IN THE FACE OF CLIMATE CHANGE: UNDERSTANDING COMPLEXITIES OF A WELL-BEING FRAMEWORK THROUGH THE EXPERIENCE OF PASTORAL WOMEN

Chapter Summary:

Frameworks for understanding well-being play an important role in designing and evaluating climate change adaptation intervention and policy. To be effective, frameworks must capture the complexities of the social, ecological and cultural contexts specific to vulnerable social groups. This study explores the concept of well-being from the perspective of pastoral women in Northern Kenya, a social group highly vulnerable to the impacts of climate change. Data was collected using semi-structured interviews and a novel participatory group ranking activity. Analysis using the WeD Framework for well-being highlights key components from the perspective of Samburu women and underscores the importance of understanding the interaction between these components. We discuss the theoretical implications of these interactions for future use of the WeD framework and practical implications for the design and evaluation of climate change adaptation intervention and policy.

Introduction:

Pastoral communities inhabiting arid and semi-arid landscapes (ASALs) in sub-Saharan Africa have long endured challenges related to drought. However, increasing frequency of drought due to climate change in combination with increasing constraints on adaptive capacity such as land fragmentation, push the limits of pastoral resilience (Galvin, 2009). In addition to these challenges, pastoral women bear a significant share of the burden of adapting to drought

(Gurmu, 2018; Westervelt, 2018) and face significant gender marginalization that further constrains their capacity to adapt and cope (Balehey et al., 2018; Eneyew & Mengistu, 2013; Ongoro & Ogara, 2012). Given these responsibilities and limitations, supporting the drought resilience of pastoral women is an important focus for policy and intervention.

In recent years, international development has moved away from using economic indicators as the sole measurement for quality of life and has instead shifted to using more nuanced and holistic indicators of well-being. Scholars also recognize the interconnectedness of natural environments and experiences of well-being (Armitage et al., 2012; J. McGregor, 2008), and in the context of changing climates, well-being frameworks provide a useful lens for understanding the multitude of ways drought, and drought-related policies or interventions impact people's lives (Patnaik et al., 2019; Rigby et al., 2011). However, such frameworks must capture the complexities of the social, ecological and cultural systems specific to social groups and their experience with climate change impacts.

Significant work has led to culturally-inclusive well-being frameworks for use in impact assessment and policy implementation in the fields of natural resource management, conservation and climate change social science (see Agarwala et al., 2014; Armitage et al., 2012; Milner-Gulland et al., 2014; Summers et al., 2012; E. Woodhouse & McCabe, 2018; Woodhouse et al., 2015). However, only a small amount of this work has been conducted with pastoral communities, and an even smaller proportion with pastoral women (e.g., Rao, 1998; Woodhouse & McCabe, 2018). This study explores how pastoral women in the Samburu region of northern Kenya, who experienced significant impacts from drought, conceptualize well-being, and discusses the theoretical and applied implications of using well-being frameworks for supporting the climate change resilience of pastoral women.

Conceptual framework:

Adaptive capacity is the ability of individuals, households and communities to adapt, and it is a critical component of climate change resilience (Adger, 2006). At the core of understanding how and why people adapt are the decisions people make to achieve and maintain well-being (Armitage et al., 2012; Deci & Ryan, 2008). As a result, well-being frameworks play an important role in guiding policy and interventions aimed at increasing the climate change resilience of communities and systems (Armitage et al., 2012).

Conceptualizing and measuring well-being

The vast body of well-being literature originates in the fields of psychology and international development (Gough & McGregor, 2007). In both fields, theories of well-being have transitioned from an initial 'deficit' approach about what people do not have, to asset-based models that focus on what people seek to achieve and maintain (Copestake, 2008). In international development, this transition has also paralleled a shift away from only economic measures of well-being towards more holistic and multi-dimensional measures of what it means to live well (Bleys, 2012; Fluehr-Lobban & Billson, 2013).

The WeD framework

In one effort to establish a holistic well-being framework, the Research Group on Well-being in Developing Countries developed the WeD framework. WeD operationalizes well-being as both subjective and objective, and draws from literature on the theory of human need (Doyal & Gough, 1991), life satisfaction (Diener et al., 1985) and the capabilities approach (Sen, 2017). Specifically, the framework defines well-being as the interplay between multiple factors: (1) the resources a person is able to command; (2) the goals they are able to achieve with those resources, and; (3) the meaning they give to the goals they achieve (McGregor, 2007).

Based on this definition, the WeD framework conceptualizes well-being into three key dimensions: the material, the relational, and the subjective. The material dimension includes goods and assets such as food, shelter, income, employment and similar standard of living indicators. The relational dimension comprises the social relationships that limits or enable a person to leverage material resources to meet their goals, and include concepts such as social capital, access to goods and services, social norms, security, and collective action. Finally, the subjective dimension focuses on people's subjective evaluation about what they have and achieved with their material and relational resources.

While most studies base their interpretations of the framework off of Gough and Mcgregor's (2007) original definition and delineation between the three dimensions, there has been some inconsistency in how the dimensions have been interpreted and operationalized. For example, Woodhouse and McCabe (2018) describe the material dimension as what an individual objectively has, while McGregor and Sumner (2010) describe the material dimension as what an individual is able to objectively achieve. As a result, Woodhouse and McCabe (2018) place livestock, land and income in the material dimension while McGregor and Sumner (2010) place these same indicators in the relational category, and place satisfaction of basic needs in the material dimension. This inconsistency in how scholars differentiate between the material and relational dimensions is contrasted by consistency in how studies apply the subjective dimension, collectively describing the subjective dimension as the evaluations and perceptions individuals have about their lives and achievement of their goals (Britton & Coulthard, 2013; McGregor & Sumner, 2010; Woodhouse & McCabe, 2018; Woodhouse et al., 2015). While the differences and similarities in these examples could be perceived as merely semantics, the subsequent categorization of well-being indicators, such as income, social capital, and natural resources,

highlights the significant impact the delineation between dimensions has on how well-being is conceptualized and measured.

For this study we used Gough and McGregor's (2007) original definition and delineation of the three dimensions which posits well-being as (1) what a person has (material), (2) what they can do with what they have (relational), and (3) how they think about what they have and can do (subjective).

While a specific definition of each of the three dimensions provides clarity, the interactions between these dimensions is also critical, and several authors have highlighted the theoretical and applied importance of these interactions. Woodhouse et al. (2015) described the WeD's dimensions as *interdependent elements* and argue that the dimensional nature of the framework counterbalances "a tendency in policy to privilege material well-being and underplay subjective feelings and the social dimension of people's lives" (p. 3). Similarly, McGregor and Sumner (2010) argue that the interaction between the three dimensions is critical to the WeD framework and highlight this interaction as one of its unique aspects. However, such interactions have rarely been examined in existing research (Woodhouse & McCabe, 2018; Britton & Coulthard, 2013).

In one of the few applications of WeD to a pastoral context, Woodhouse and McCabe (2018) used a case study analysis to understand well-being from the perspective of Maasai communities in northern Tanzania. The results of the study highlighted the heterogeneity of how well-being is conceptualized across age, gender and community. They asked both men and women to describe "the good life" and found differences in perspectives between genders, as well as between age groups amongst men. The authors argue for the critical role well-being needs to play in supporting effective and ethical conservation and development policy in a

system heavily impacted by drought. However, neither Woodhouse and McCabe (2018) nor other authors discuss the implications that interactions between well-being dimensions could have for such policy and intervention in systems heavily impacted by climate change.

To address this gap, this study applies the WeD framework to understand well-being from the perspective of pastoral women in northern Kenya, with a specific focus on the interactions between the WeD framework's dimensions. We subsequently discuss the implications for using well-being frameworks, specifically the WeD framework for supporting and policy and intervention aimed at increasing the climate resilience of pastoral women in East Africa.

Methods

Study area: Waso East, Samburu Kenya

Ecology and climate: The Waso East district is approximately 4,950 km^2 and located in the lowlands of southern Samburu, Kenya. ASAL regions in East Africa more broadly, are characterized by unpredictable precipitation, and increased frequency of drought due to climate change (Serdeczny et al., 2017; Thornton et al., 2006). On average, Waso East receives 350 mm with peaks in April and November (Wittemyer, 2011; Pas, 2018). However, few years within the last few decades closely represent this average, with some years notably drier and others notably wetter. The mean average temperature ranges between 18 and 30 degrees Celsius. The Samburu region is also a biodiversity hotspot, home to several endemic and imperilled species such as Grevy's zebra *(Equus* grevyi*),* reticulated giraffe (*Giraffa* camelopardalis reticulata*)*, and Beisa oryx *(Oryx* beisa*)* and over 450 recorded bird species. As the frequency and severity of drought increases, intensified grazing in addition to other ecological disturbances (e.g. invasive species, land fragmentation, changes in fire regimes) has resulted in a degraded landscape leading to

significant negative impacts on both wildlife and pastoral livelihoods (Vågen & Winowiecki, 2014).

Pastoralism and livelihoods: Archer's Post, the largest settlement in Waso East, is a community of approximately 6,000 people (Samburu County Government, 2017). The region is home to historically nomadic pastoral groups, including the Samburu, Turkana, Rendille and Borana tribes. Traditionally, households moved with their herds in search of pasture and water and relied solely on livestock and foraging for basic needs (Spencer, 1965). However, communities have transitioned to a more sedentary lifestyle in response to several government policies and an increased desire for access to services such as schools, markets and health care facilities. Trading livestock at markets is one of the primary ways pastoralists provide for their families, although livestock continue to play an important non-economic role in cultural practices and ceremonies as well (Holtzman, 1996). However, a complex interaction of non-climatic factors such as land-fragmentation, insecurity and limited grazing rights have reduced the mobility of pastoral communities and resulted in intensified and sedentary grazing (Vågen & Winowiecki, 2014). In addition livestock, diversified livelihood strategies such as small business and tourism enterprises are increasingly common in response to both push and pull factors, such as increased drought and access to new markets (Lenaiyasa et al., 2020).

Social Structure and Gender: In addition to significant economic and ecological shifts, gender roles in Samburu are increasingly dynamic and complex (Holtzman, 1996). Cultural practices and beliefs around polygamy, child marriage, education, female genital mutilation, domestic violence and property rights are complicated and should not be over-simplified as rooted only in gender inequities, but they inarguably limit the agency and well-being of women in communities across the region. While gender norms strongly influence community structure

and decision-making processes (Holtzman 2001), these norms are undergoing significant and rapid change (Mogambi & Ochola, 2015; Straight, 2000). Additionally, age sets are of particular importance to Samburu culture for both men and women; age set often determines who people spend time with, their daily activities, and their role in the community.

Site

This study was conducted with women from the greater Archer's Post community in the Waso East district of Samburu. While women in this community share many similarities in terms of their day-to-day life experience, participants in this study lived anywhere between 2 km to 10 km away from Archer's Post town. As a result, their households have varying access to pasture, water sources, clinics, schools and other resources.

Research ethics

Our research team consisted of six local community members and two Western researchers from an American university. The team members who led data collection were all women from the participating communities. All members of the team played a role in designing the study, creating and piloting methods, and ensuring the methodology was culturally appropriate. Three of the local research team members also supported analysis and discussed the implications of the results. In addition to the research team, a group of local advisors (prominent women leaders in the community), gave regular feedback on the project and supported the dissemination of results.

Permission for conducting this research was gained both through Colorado State University Institutional Review Board (IRB) and through consultation with local elders and community leaders. Results from the study were shared and discussed with participants, and

dissemination workshops with local organizations are planned to strengthen their climate resilience and development initiatives.

Sampling

Given the cross-cultural differences between the researcher and the participants, as well as the cultural norms in the region around relationships, purely randomized approaches were neither practical nor ethical. A history of extractive-type research in the region has resulted in unclear or negative sentiments toward research, which has made relationship-building an essential research step in order to overcome these sentiments. Therefore, prior to the commencement of data collection, the primary author visited the area in advance to interact and establish relationships with community members, often in partnership with local research team members. Individual participants were selected using a snowball sampling approach that resulted in participants of diverse age sets, formal education experience and socioeconomic status. However, it should be noted that Samburu women have very diverse life experiences and our participants, and their perspectives are specific to women living within the greater Archer's Post community. Additionally, a snowball sampling approach often results in participants recommending potential participants that are similar to themselves (Woodley & Lockard, 2016), resulting in a biased sample and a potential limitation to our study. Additionally, while we were able to make sure our sample included women whose homes were located various distances from the town centre, represented a variety of ages, and had a diversity of formal education, we did not control for wealth, creating an additional limitation of our study.

Data collection

Data was collected using two methods. First, individual semi-structured interviews were conducted with 30 women to define what it means to have a "good life" (see Woodhouse &

McCabe, 2018). Participants were asked to discuss the aspects of a person's life that determine whether one has a "good life," and describe stories about times where they felt satisfied with their lives. The interviews were dynamic and often included non-scripted prompts based on our research team's prior relationship with the participant (see Glesne, 2016). Interviews were conducted in the Samburu language (a dialect of *Maa*), facilitated by a local team member, and audio recorded. Analysis of transcripts resulted in 12 themes and 28 sub-themes.

Themes and subthemes were then drawn by a local artist (see Figure 3) for use in the second method, an activity entitled "Build Your Best Life (BYBL)". Drawings were used in combination with verbal prompts to increase accessibility of the activity to population with low literacy levels. Additionally, the drawings provided an easy, comfortable and interesting introduction into the activity that seemed to engage participants quickly. The drawings of themes and subthemes were shown to participants in groups of three to four women. Each participant group was shown the same images, in the same order, and asked to collectively select the three images they would prioritize most highly in order to have a 'good life.'

The method was pilot tested with five different participant groups prior to data collection. After the completion of the piloting, participants were asked questions about the clarity of the activity. Subsequently, our local research team reviewed the data from the pilot testing and the feedback from participants and made adjustments. These adjustments included bundling the images in three groups to help simplify the task as well as selecting 19 of the total 40 themes and subthemes to include in the activity, after piloting indicated some images were too abstract or similar to each other for participants to effectively prioritize.

The activity was facilitated by a local research team member while two other local team members took notes on each group's choices and discussion. The BYBL method was developed

by our research team and based on prior experience conducting research in Samburu using paired comparison methods (Bruyere et al., 2018b), focus groups (Walker et al., 2020) and participatory methodology more broadly (Beh et al., 2013). The purpose of the activity was to both capture contextual data about each of the themes from a larger group of participants as well as gain an understanding of which themes were most important or salient to participants.

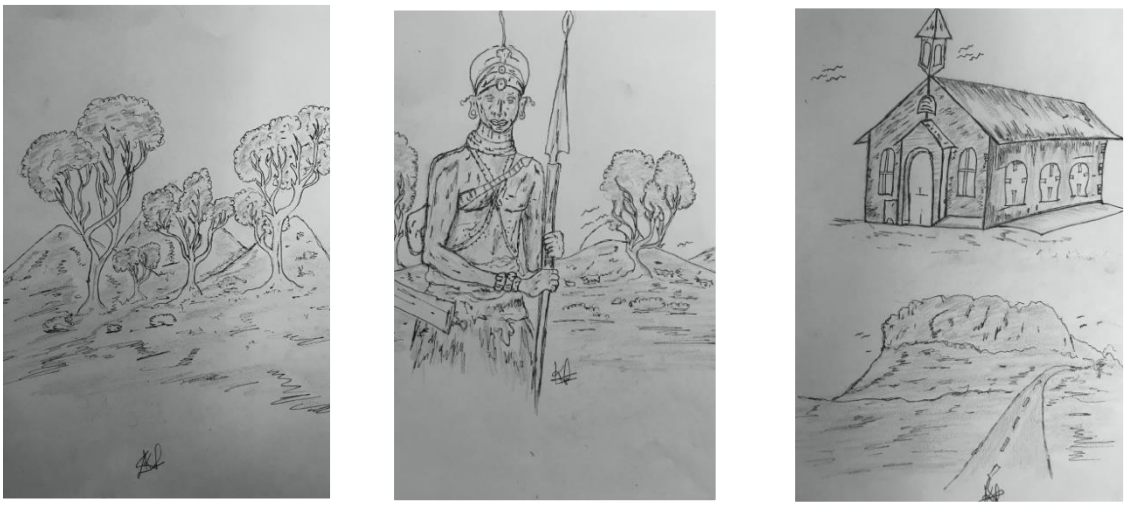

Figure 3. Example of illustrations by local artist used in BYBL method.
Example illustrations represent (left to right) healthy natural resources (material), safety (relational) and spirituality (subjective)

Data Analysis:

Audio recordings of the interviews were transcribed into Samburu and translated into English. All translated transcripts were reviewed a second time to ensure accuracy. In addition, local team members took notes during the BYBL activity, noting participant discussion about the rationale for why specific themes were selected as a top three priority.

Thematic analysis was used to analyse the interview transcripts and group discussion notes from the BYBL method. Following Braun and Clark's (2006) protocol for thematic analysis, data was reviewed multiple times to build familiarity with the data, and then codes were

generated. Codes were then organized into themes and subthemes of well-being using the WeD framework. Next themes and their respective subthemes were reviewed, defined and named, leading to interpretation and preparation of final results. Thematic analysis was conducted using NVivo software.

Results

Thirty (30) women from three age groups participated in the interviews: 23% from ~ 18 - 30 years, 43% from ~ 31- 45 years, and 34% from ~ 46+ years. In addition, 70% of women had no formal education, while 30% had at least some formal schooling, ranging from three to 12 years.

The BYBL method was conducted with 20 groups, with three to four women in each group, for a total of 78 participants. The women represented multiple age groups (29% from ~ 18 - 30 years, 41% from ~ 31- 45 years, and 30% from ~ 46+ years) and approximately 30% had some experience with formal education. Approximately 20% of women who participated in BYBL activity also participated in the interviews.

Our analysis of the interview data revealed 12 themes and 28 subthemes representing what women identified in the interviews as important for the 'good life.' After discussion with our research team, we determined that two of the 12 themes (*being alive* and *overcoming challenges*) referred to more broad and abstract aspects of well-being compared to the other 10 themes and could not be logically attached to any of the three WeD dimensions. A more detailed rationale for this decision is outlined in the description of the themes. The remaining 10 themes and associated subthemes were assigned to one of the three WeD dimensions following the work of Gough and McGregor (2007), resulting in three themes as *material*, four themes as *relational*,

and three themes as *subjective* (see Figure 4). Each theme consisted of between zero and four subthemes.

Description of themes: Material themes

Theme: Basic needs
Subthemes: Water, food, shelter
Most often discussed in conjunction with: Financial security

The importance of meeting *basic needs* was a common theme in the interviews. Three common subthemes of *basic needs* were *food, water* and *shelter. Water* and *food* were often discussed in the context of 'having enough' while *shelter* was discussed both in the context of "having a home" and the quality of the home. Unique to *water*, was the connections made to other aspects of women's lives. Many women explained that *water* is essential to fulfil all of the daily activities a woman is responsible for, such as taking care of young livestock, cooking and washing clothes.

Basic needs were often mentioned in the context of other themes about the good life, such as *financial security, positive cognitive states* and *rewarding relationships with others*. For example, one interviewee described this interaction between *basic needs, financial security* and *relationships with others:*

> *You work hard to find other means, so that your children will not get hungry in the dry season. You work so hard so that your children will get food to eat, even if somebody calls you to do laundry and pay you, so that you buy food for your children.*

Theme: Natural resources
Subthemes: Clean air, pasture, rain
Most often discussed in conjunction with: Positive cognitive states

When describing the 'good life' many women referred to the health of the environment. More specifically, they discussed clean *air*, *healthy pasture* and sufficient *rain*. All three of these

subthemes were discussed in the context of their utilitarian value: *clean air* for breathing, and *healthy pasture* and *rain* for livestock.

Women also connected a healthy rangeland to positive cognitive states, explaining that sufficient pasture and water brings the livestock home, uniting families and communities. *'When there is green pasture, we have... happy moments since our animals are at home'.*

Theme: Financial security
Subthemes: Employment, property, savings, livestock
Most often discussed in conjunction with: Agency

Financial security was one of the most frequent themes from the interviews, and most often discussed as a means of achieving outcomes and assets represented in many of the other themes.

Owning *livestock,* and more specifically owning healthy *livestock*, was the most frequently mentioned example of *financial security* and discussed as an essential component of having a good life. One woman explained that having *livestock* was critical to achieving other aspects of the good life:

> *If I have my own livestock, I can feel that I'm good because livestock are the only ones who can help, even in an emergency. If I feel that I'm not feeling well, my own livestock are the ones who can help me because I can go and sell them and buy medicine for my home. I can even sell them to pay the school fees for my children.*

The utilitarian value of livestock, compared to their cultural value, was the most frequently discussed rationale for their inclusion in the good life. Some women explained that the value of *livestock* comes from their ability to provide essential *basic needs.*

Financial security was discussed in relation to other themes such as *agency, relationships with others*, and *basic needs*. Women discussed a job and other non-livestock means of making of living as important for providing a sense of independence and agency. For example, one participant stated: '*Having a job is better because one will not depend to others since she works*

for herself so to sustain all her basic needs.' Women also linked *financial security* to being able to *provide for their children* and families.

Description of themes: Relational themes

Theme: Agency
Subthemes: Freedom to make choices, choices have meaningful impact
Most often discussed in conjunction with: Financial security

The theme *agency* represents the ability to do something about one's situation. This theme is comprised of two subthemes: having the *freedom to make choices* and living in an environment *where choices have a meaningful impact*. Women discussed being able to rely on themselves to provide for their family and being able to do what they "wanted." For example, one participant said '*Yes (I have a good life), because I make my own choices. Because God gave me a life, I don't expect to depend on somebody to make decisions for me. I have to depend for myself to have a good life*'.

Women often linked *agency* with *financial security* and being able to help others in times of need, resulting in a *good heart*. They also frequently discussed the feeling of *'not being able to do anything'* about a situation as an indicator of not having a good life, which was often discussed in the context of drought. Many women said that during a *riai* (Samburu term for extreme drought), for example, they cannot have a good life, because there is nothing a person could do to change the situation.

Theme: Health
Subthemes: Freedom from illness, having energy, freedom from substance abuse
Most often discussed in conjunction with: Relationships with others

Participants described good *health* as an essential part of having a good life. Women often discussed *health* as a lack of illness or as *having the energy* to carry out daily responsibilities. *Health* was also discussed in the context of loved ones, including the health of

children and family members, as well as the health needed to provide for children. One participant stated:

> *If I wake up and feel like I don't have anywhere in my body that's hurting, I will go and do what I want to do or do work that I am capable of doing. But if I wake up and feel sick, that shows that I don't have a good life.*

There was no discussion about health care or access to health care, or about treatment of illnesses. Rather, all comments were framed as maintaining *health* or preventing illness. Women often linked *health* to other dimensions, such as *relationships with others*. Their own *health* made them capable of taking care of others, and in times of poor *health*, they needed others as caregivers. For example, one participant noted needing her husband when she was ill to care for her and her children*: 'When I'm... sick and I have my husband because he will look for food for the kids and then sometimes when I give birth, he will take care of the kids.'*

Theme: Safety
Subthemes: none
Most often discussed in conjunction with: Agency

Safety was almost always discussed in the context of tribal conflict. Women described *safety* as not having to worry about violence between tribes. They also described the uniting power of safety; security from violence enabled people continue to live in their communities together.

Safety was often discussed in tandem with *agency*, specifically the subtheme of *choices having meaningful impacts*. Some participants explained that tribal violence was something out of their control and therefore limiting their *agency* and negatively impacting their well-being. For example, one participant explained:

> *There is always challenges or problems, that keeps coming in someone's life that I can't control. For example, when Turkana fights with Samburu, it's hard to control that and to have a good life.*

Theme: Relationships with others
Subthemes: Having friends, having children, providing for your children

Most often discussed in conjunction with: Positive cognitive states

Relationships with others was discussed in both the context of family and neighbours. There were three subthemes for *relationships with others*. First, having strong relationships with *friends*, which was often explained in the context of social capital; in a time of need, *friends* provide support.

Second, women explained that *having children* was one of the most critical aspects of a good life for a Samburu woman. Women argued that a women's identity was intrinsically linked to her role as a mother. Some women went as far as to say that a woman had little to no significance in the community if she lacked children. This was illustrated by the common system following childbirth, when a mother is then referred to in relation to her child's name (e.g. 'Mama Nahla' or 'Mama Gumato'). Women discussed having kids as building a legacy for their families and raising future leaders.

Women also brought up the practical role of children, such as helping herd livestock, support domestic chores and take care of parents as they age

Third, women discussed being able *to provide for their children* as critical to the good life. For example, one woman said, '*If my children have food, if they are all in school and there are no children that have stress, that's when I have a good life, because I don't have stress.'* Sending children to school and making sure they had enough to eat was the most frequent context in which providing for children was discussed. Women connected children attending school with the potential for a better future, specifically in terms of better livestock management, better community leadership, keeping young adults away from bad influences, and having wealthier children to take care of their parents as they age. Notably, there was no reference about gender when discussing sending children to school.

Relationships with others was often linked with other themes such as *agency, freedom from stress, financial security* and *basic needs.* For example, women rationalized the importance of *agency* so that they could care for their children:

> *If I have my own (livestock), I can feel that I'm good because... my own livestock are the ones who can help me because I can go and sell them and buy medicine from my home. I can even sell them to pay the school fees for my children.*

Description of themes: Subjective themes

Theme: Spirituality
Subthemes: Having faith in God, following God, praying to God
Most often discussed in conjunction with: Health

Along with *being alive, spirituality* was one of the most frequently coded themes, and discussed as essential for a 'good life' by almost all participants. Participants' discussion of their spirituality was coded into three subthemes. First, when asked what it means to have a good life, a majority of participants answered with 'having my God' or 'knowing' or 'believing in God.' Second, women described the good life as one in which you were *following God* (e.g., by loving others and following rules laid out in religious texts). Third*, praying to God* was the most commonly used phrase to describe an individuals' spirituality and referenced praying to a Christian God as well as praying to the mountains and wildlife.

Discussions of spirituality frequently overlapped with discussions around sense of control, often stating that the good life was ultimately under God's control and discussed God as the provider of assets in other themes such as *Health.*

Theme: Good heart
Subthemes: Kind behaviours to others, freedom from jealousy, sympathy for others
Most often discussed in conjunction with: Relationships with others

Having a *good heart* was the most frequently coded theme from the interview data. Women described having a *good heart* as a self-evaluation of how to think about and treat other

people. In this theme, many participants described behaviours that exemplify a person with a *good heart*. One woman described having a *good heart* as '*even if you want to fight with somebody, you just leave and wish good things to happen. You have a good heart.*' Subthemes include *kind behaviours towards others*, which described actions such as not *'fighting with others'* and *'not speaking poorly of others'; freedom from jealousy; and sympathy for others.* While different people used varying examples, almost all participants used the exact phrase of *ltau supat* (*Samburu* for good heart) as essential to having a good life. A *good heart* was often discussed in connection to *relationships with others* and *positive cognitive states*.

Theme: Positive cognitive states
Subthemes: Happiness, hope for the future, satisfaction with life, freedom from stress
Most often discussed in conjunction with: Relationships with others

The theme of *positive cognitive states* represents a number of positive emotions and feelings. *Freedom from stress* was the most commonly referred to positive cognitive state. Women discussed experiencing these *positive cognitive states* as critical signs of the 'good life'. For example, one participant explained '*The happiness I have when I'm waking up, that's how I know I have a good life'.*

Many of the other themes such as *basic needs*, *financial security*, *relationships with others* and *health* were discussed in conjunction with positive cognitive states. For example, one woman explained that ensuring her children experienced *freedom from stress* was an important driver of her own experience with stress: *'when there is no children that have stress, that's when I have a good life, because I don't have stress.'*

Description of themes: Non-dimensional themes

Theme: Being alive
Subthemes: none
Most often discussed in conjunction with: Spirituality

The theme *being alive* was one of the most common themes throughout the data. When asked what it meant to have a 'good life' many women answered with phrases such as or similar to '*being alive*' or '*just waking up in the morning*.' *Being alive* was often a participant's first answer when asked to explain the *good life* and was frequently discussed in conjunction with the theme of *spirituality and health*. Example phrases that were coded as *being alive* included: '*waking up in the morning*,' '*just being alive,*' and '*breathing.*' Additionally, this theme often was mentioned alongside expressions of a theme of spiritual gratitude, acknowledging that '*God is the giver of life'* and simply *being alive* was a gift, and that all life was 'good.'

Comments coded as *being alive* were almost always followed by comments that were coded to other themes. This theme did not align with the material, relational or subjective dimension of WeD. Further, our research team felt that being alive is a requirement for experiencing any type of life, good or bad. As a result, we decided to omit *being alive* from the BYBL method.

Theme: Overcoming challenges
Subthemes: None
Most often discussed in conjunction with: Spirituality

Another important theme from the data is the role that experiencing and *overcoming challenges* plays in the *good life*. Women discussed challenges in two key ways. First, they discussed experiencing challenges as a natural aspect of life: '*it's a must (experiencing challenges) because when you are living in this world you have to experience challenges, at the same time you can have a good life*.' Experiencing challenges does not prevent a woman from having a good life; in fact, women discussed the ability to overcome challenges as a key indicator of the good life. Unlike other themes that were discussed as components of the 'good life', *overcoming challenges* was discussed as a more holistic description of a good life; you

need all these different components of the good life to rely on as you overcome the inevitable challenges you will experience in your search for the good life. Women discussed *overcoming challenges* as a complex and multi-faceted process essential for having a good life; one that was possible when the other components of a good life are present. This theme did not fit the WeD framework and as a result, was not placed in a dimensional category and subsequently omitted from the BYBL method. However, the omission from BYBL does not illustrate the unimportance of this theme. Over-coming challenges was frequently discussed in the context of drought, as drought creates a variety of challenges women have to overcome in order to have a good life. Many women articulated that drought can create such significant challenges, that having a good life becomes impossible.

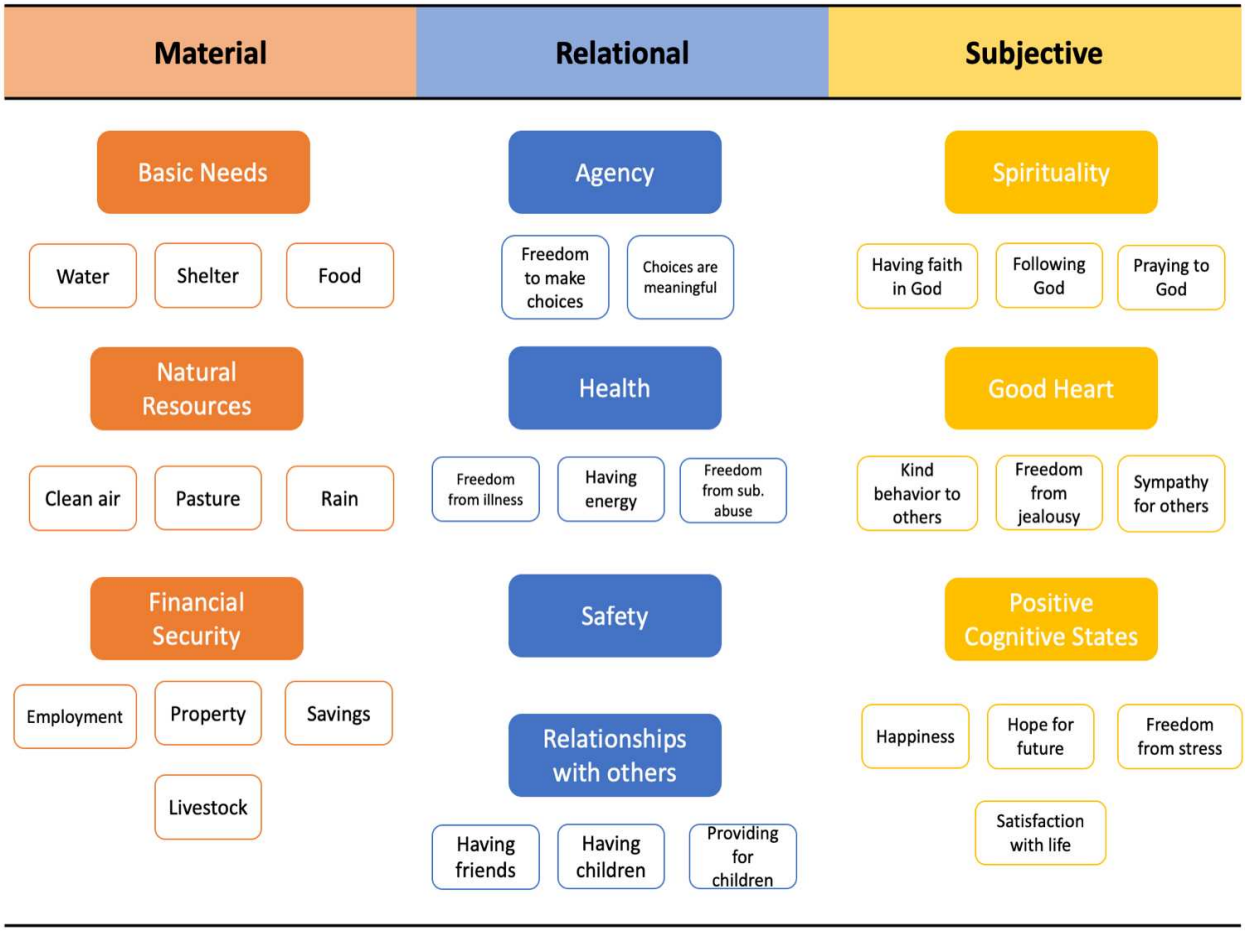

Figure 4. Organization of themes, subthemes and association with Wed Dimension

A second analysis was conducted with the BYBL data. A score of one (1) was given to a theme/subtheme (represented by images) each time it was selected by a group. Points for each theme/subtheme were summed, providing a frequency count for each (see Table 1 for results). Images that were chosen as a top three priority by more than 50% of groups included: *sending children to school having children*, *good heart, agency, spirituality, water, providing basic needs for children*, and having *livestock*.

Table 1. Build Your Best Life results including frequencies, mean ranking scores by all participants

Image shown to participants	**Theme** *Dimension*	**# of times chose as a top 3 priority[1]**	**Overall ranking**
Sending children to school	Relationships with others *Relational*	20	1
Having children	Relationships with others *Relational*	17	2
Good heart	Good heart *Subjective*	16	3
Agency	Agency *Relational*	15	4
Spirituality	Spirituality *Subjective*	15	4
Water	Basic Needs *Material*	14	6
Providing basic needs for children	Relationships with others *Relational*	12	7
Livestock	Financial security *Materia*l	10	8
Natural Resources	Natural resources *Material*	9	9
Giving to others	Good heart *Subjective*	9	9
Property	Financial security *Material*	8	11
Safety	Safety *Relational*	7	12
Shelter	Basic needs *Material*	6	13
Savings	Financial security *Material*	6	13
Employment	Financial security *Material*	5	15
Positive cognitive states	Positive cognitive states *Subjective*	4	16
Health	Health *Relational*	3	17
Friends	Relationships with others *Relational*	2	18
Food	Basic needs *Material*	2	18

1 = maximum total is 20

Integration of themes:

As demonstrated by the descriptions of each individual theme, almost every theme was discussed in relation to another theme, often characterized by statements such as *'A leads to B, and B leads to C'*. Figure 5 illustrates some of the most salient connections made by participants during interviews and the BYBL activity.

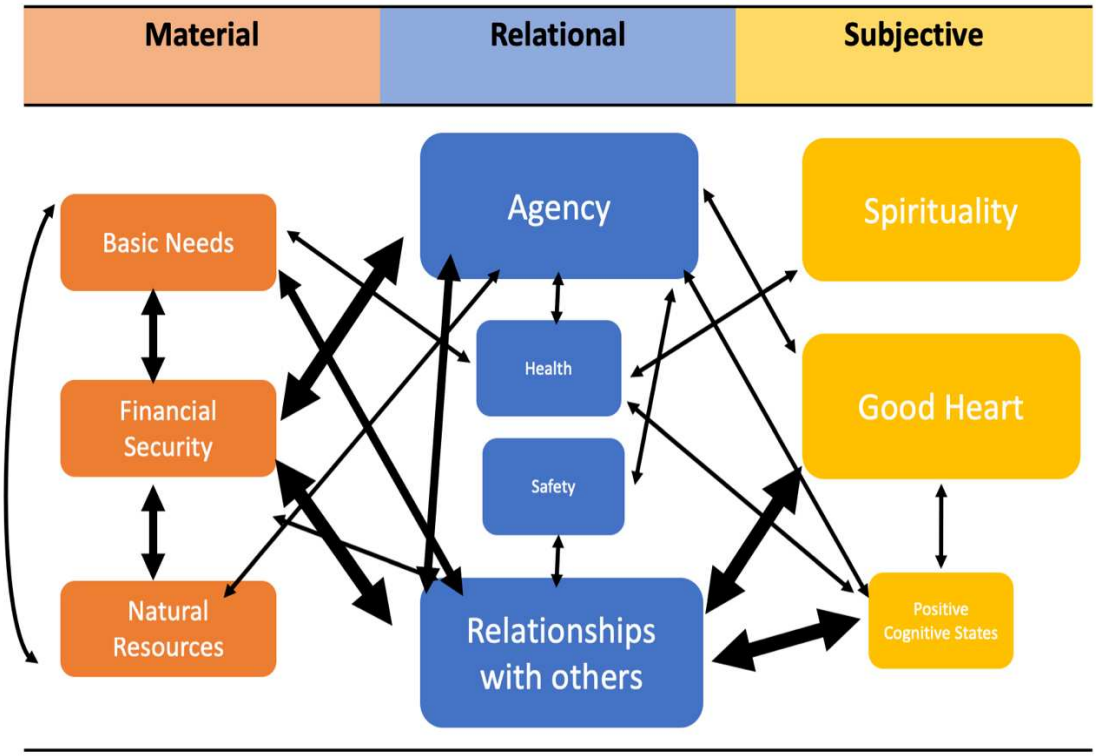

Figure 5. Linkages between well-being themes.

The size of the boxes around each theme indicates how highly each theme was ranked in BYBL. The arrows indicate linkages between themes, and the weight of the arrows indicates how often the link between the components was mentioned during both interviews and BYBL

Discussion:

Women in Samburu are constantly adapting and adjusting to stressors, including climate-related stressors, as they work to secure and maintain well-being for themselves, their families, and communities. The concept of well-being is critical for understanding and supporting social-

ecological resilience as it provides an ultimate goal for interventions aimed at increasing the resilience of communities, households and individuals (Armitage et al., 2012; Béné, Frankenberger, & Nelson, 2015; Béné et al., 2012). However, in order to design such interventions in ways that are appropriate for local context, culturally relevant and place-based frameworks are essential. The results of our study provide an example of such a framework for the context of Samburu women in the Waso East region.

Our results indicate that participants conceptualize well-being in 12 unique ways and prioritize *spirituality*, a *good heart*, *agency* and *relationships with others* as the most important aspects of their well-being. These themes fit well within and support the three-dimensional framework outlined in WeD. Additionally, when a well-being theme or subtheme was discussed by participants, it nearly always led to further discussion about another theme or subtheme. For example, the theme of *financial security* (*material*) was discussed as enabling women to provide for their children and families (*relational*) leading to feelings of *freedom from stress* (*subjective*). Similarly, *health* (*relational*), while partially attributable as an outcome of meeting *basic needs* (*material*), was often described as a requirement *for agency* (*relational*) subsequently linked to the ability to take care of one's family, leading to *freedom from stress* (*subjective*). Additionally, *agency* (*relational*) refers to the ability of people to make choices with what they have (*material*), leading to *subjective* themes such as *positive cognitive states* and being kind to others (*subtheme of good heart*) by capacity to give material assets to others.

These linkages between components have important implications for how we conceptualize well-being using the WeD framework and for policy and interventions that seek to support the well-being of pastoral women as they adapt to the stressors of climate change.

Linkages between WeD Dimensions: Implications for conceptualizing well-being

Previous literature has explicitly stated the importance of considering components of well-being in relation to one another (see Britton & Coulthard, 2013; Woodhouse & McCabe, 2018; Woodhouse et al., 2015). However, few studies have provided actual examples of how different components interact across the three dimensions, and the subsequent implications of such interactions. Our results suggest that well-being components within the three dimensions of well-being rarely occur in isolation; each one builds on, from, or influences, another.

These interactions have important implications for how we conceptualize, rationalize and measure well-being. For example, women in Samburu prioritized well-being assets within each dimension, such as access to *basic needs (material dimension), a good heart (subjective)*, and *relationships with others (relational)* as most important. Without consideration to how the components interact, food and water, for example, would likely be understood as fulfilling mostly a physical health need. But it does more than that: it leads to *freedom from stress (positive cognitive state),* which can have positive implications for her relationships with others. Similarly, *agency*, if thought about in isolation from other themes and dimensions, would be thought of only as individual decision-making power. In reality, it has important collective implications, as participants explained that it increased their ability to share resources *with others,* achieve *financial security and* experience *freedom from stress*. These linkages provide additional depth to high priority components by highlighting how they influence and are influenced by seemingly less salient components.

Additionally, if we only examine the components of well-being in isolation from one another, less salient but important components stand to be ignored. This can result in incomplete or overly simplistic well-being frameworks. For example, *positive cognitive states*, when examined individually, emerged as a third-tier priority (in the BYBL analysis). Two other

components were prioritized more highly within the same *subjective* dimension. However, in our analysis of women's discussions, *positive cognitive states* were frequently connected to other highly prioritized components; *relationships with family and friends* brought *happiness* and *freedom from stress*; *agency* brought *feelings of optimism,* and *freedom from stress* enabled women to be kinder to one another. When considered independently, *positive cognitive states* appear as a tertiary component of well-being; when considered in context of other components, it is arguably one of the most important components of well-being. These results also call into question the usefulness of ranking data when analysed in isolation. Our ranking data is an important aspect of our results, but on its own, tells an incomplete narrative of Samburu women's experience with well-being.

Implications for policy and interventions

An increased focus on the interaction between dimensions and their associated components is particularly important for policy and intervention design related to development initiatives, such as climate change adaptation. Well-being is relevant to such a context because it is both an important driver of decision-making (Deci & Ryan, 2008) and in turn, adaptation (Armitage et al., 2012). As a result, well-being is often an outcome variable in theory of change models used to design and implement interventions focused on improving adaptive capacity to climate change (Agarwala et al., 2014; Armitage et al., 2012; J. A. McGregor et al., 2009). When we move away from siloed frameworks of well-being and consider cascading impacts between different components of well-being, we increase the accuracy of theory of change models, and subsequently, the efficacy of interventions in two key ways.

First, the effectiveness of interventions can be increased by understanding how different variables interact with one another. Take the example of a micro-loan programs, a commonly

used intervention focused on climate adaptation with women by several NGO's in the Samburu region. Such an intervention might use well-being indicators as a measure of the program's effectiveness. One potential theory of change model for a micro-loan program might posit that increasing the short-term financial resources of women would lead to an increased ability to invest in adaptive livelihood strategies. In turn, this could lead to increased adaptive capacity to climate stressors and ultimately well-being components such as *freedom from stress* and *basic needs*.

Conversely, a theory of change model that recognizes the relationships between themes of well-being would also posit that relational components of well-being, such as *agency* and *safety*, play an important role in women's ability to leverage *financial resources* into *freedom from stress* and *access to basic needs*. In our study, participants explained that tribal security in the region decreased their sense of agency as it limited their ability to make adaptive choices. An intervention that considers the temporal patterns of local violence and the impact such insecurity has on women's agency, could implement programming during times when insecurity is less likely to occur or include training that addresses the risk of tribal violence to livelihoods in addition to micro-loans. This adaptation to the intervention could increase the likelihood of participants investing in alternative livelihood strategies, and ultimately securing basic needs and freedom from stress despite climate stressors. By understanding how components of well-being impact one another, interventions can be designed in ways that more effectively address potential barriers.

Second, recognizing the relationships between the different components of well-being also provides more opportunities for intervention. Take the same example of a climate change adaptation intervention working to increase access to adaptive livelihood strategies by providing

micro-loans to Samburu women. A theory of change model that places well-being as the long-term desired impact, points to economic options for interventions. However, recognition of the linkages between well-being components highlights other options in addition to economic interventions, such as interventions that leverage agency, which has the potential to positively influence other aspects of well-being. Such an intervention might actually seek to increase women's decision-making power by providing education opportunities like financial literacy or small business training in addition to providing credit access to support alternative livelihoods. Ultimately, recognizing the interactions between dimensions highlights multiple avenues for interventions and encourages adaptive management of interventions within unique and dynamic systems.

Conclusion

Samburu communities and pastoral communities more broadly, are living with the impacts of climate change. These impacts, in combination with the social, economic and institutional constraints on their ability to respond, threaten the viability of pastoralism livelihoods and the well-being of those who practice them. As a result, increasing the climate resilience of pastoral communities, and the resilience of vulnerable groups within these communities, is a critical focus for policy and development intervention. Well-being frameworks provide useful indicators for such interventions and policies because they are more holistic than more commonly used economic indicators, and when used appropriately, account for diversity in local contexts. However, for indicators of well-being to most effectively support interventions and policies aimed at supporting climate resilience, well-being frameworks need to be created from the perspectives of people living with reality of climate change and account for the interaction between the various components of well-being.

Recognition of the interactions between components can support effective climate resilience by providing an increased number of pathways for potential intervention and encouraging interventions to more accurately reflect the context in which they are situated. Because disturbances such as climate change occur in increasingly complex social-ecological systems, well-being frameworks need to similarly reflect that complexity.

The results from this study are specific to a single group of women from Samburu, Kenya and should not be generalized across cultures and gender. However, the linkages between themes and dimensions of well-being demonstrated by our data provide guidance for how to conceptualize and measure well-being in ways that honour the unique perspectives of vulnerable social groups as they adapt to the increasing pressures of climate change.

CHAPTER 3: EDUCATION AND ADAPTIVE CAPACITY: THE INFLUENCE OF FORMAL EDUCATION ON CLIMATE CHANGE ADAPTATION OF PASTORAL WOMEN

Chapter Summary:

Adaptive capacity is an important concept for understanding the climate change resilience of social-ecological systems. A gendered lens is of particular importance to this concept as women are simultaneously one of the most vulnerable social groups to climate change and carry a significant burden of adaptation. Individuals' adaptive capacity is partially determined by learning and cognition, specifically one's ability to process, assess and react to a changing climate. Formal education experience is thought to increase the learning and cognitive aspects of adaptive capacity. This study uses a novel method, Participatory Adaptation Scenario and Mapping Activity (PASMA) to explore the influence formal education may have on the decision-making processes of pastoral women as they adapt to drought in Samburu, Kenya. Our results indicate participants with formal education may be more risk-averse once negatively impacted by drought, but initially assess and react to signs of drought similarly to their peers without formal education experience. We explain and contextualize our results using a dimensional theory of adaptive capacity, systemic issues in the formal education system, and potential ecological impacts. We subsequently discuss the implications for more effectively capitalizing on formal education's potential to support pastoral women's adaptive capacity.

Introduction

Communities and ecosystems around the world face significant threats from climate change (Conway et al., 2019; Zaroug et al., 2019). Social-ecological systems characterized by both extreme poverty and high biodiversity are some of the most vulnerable systems to such

threats (Fields, 2014). To mitigate the complex and dynamic impacts of climate change, increasing the ability of these systems to adapt has become a priority for international development and conservation initiatives worldwide (Cinner et al., 2018; Smit & Wandel, 2006).

Gender is recognized as an important piece of this solution, as gender equity is associated with positive economic, social, and ecological outcomes that support systems-level resilience (Aregu et al., 2016; Kabeer, 2012). Women are one of the most vulnerable social groups to climate change (Anbacha & Kjosavik, 2019b; Balehey et al., 2018; Onwutuebe, 2019) and in many communities around the world, are increasingly responsible for carrying the burden of adapting to changing climates (Arora et al., 2017; Mnimbo et al., 2016; Onwutuebe, 2019). As a result, conservation and development initiatives have focused some climate resilience efforts on supporting the adaptive capacity of women, including increasing access to formal education for women and girls (Dube, 2014; Kwauk & Braga, 2017).

The pastoral communities of Samburu, Kenya live at the nexus of this environmental, development, and gendered circumstance. Climate change and drought are a growing problem for Samburu's semi-arid landscape, an ecosystem already suffering from several ecological threats, and one that supports pastoralism as a primary livelihood for a significant portion of the region's 310,000 people (Kenya National Bureau of Statistics, 2019). As these ecological issues converge with social drivers such as poverty, shifting gender roles, and globalization, Samburu women are increasingly responsible for adapting to the stressors of climate change.

The efficacy of development strategies on climate resilience, including increasing access to formal education, is not well understood and requires additional investigation (Muttarak & Lutz, 2014; Striessnig et al., 2013). This study explores the influence of formal education

experience on adaptive capacity for women in Samburu, as they make decisions to sustain their pastoral livelihoods and well-being.

Understanding adaptive capacity

In the context of social-ecological systems and climate change stress, Smit and Wandel (2006) broadly define adaptive capacity as human actors' ability to change behavior in response to a stressor. This concept is of particular importance for communities experiencing current and future stressors associated with climate change.

A significant portion of the climate adaptation literature suggests that the adaptive capacity of communities and households is largely a function of the resources to which they have access, and their ability to leverage such resources (Adger et al., 2003; Andrijevic et al., 2020; Brooks et al., 2005; Cinner et al., 2018). Cinner et al. (2018) brought clarity to the 'ability to leverage' aspect of adaptive capacity with their dimensional theory. Their framework is based on research in tropical coastal communities experiencing severe climate change impacts and includes five domains: (1) the *assets* that individuals can rely on (2) the *flexibilit*y to utilize different adaptation strategies; (3) the ability to collectively *organize* and act ; (4) *learning* how to understand and react to a changing system; and (5) the *agency* to act or not. The authors specifically define the learning domain as the ability of individuals to "generate, absorb, and process new information about climate change, adaptation options, and ways to live with, and manage, uncertainty" (p. 119).

Literature from a variety of disciplines underscores the importance of the *learning* domain of adaptive capacity, particularly people's ability to process climate information, such as assessing risk and potential adaptation strategies (see Abdul-Razak & Kruse, 2017; D'agata et al., 2020; Grothmann & Patt, 2005; Yaro et al., 2016). Grothman and Patt (2005) argued that this

individual and cognitive component of adaptive capacity is an overlooked and underestimated determinant. In their study, the two most important factors that determined adaptive capacity were climate risk appraisal (i.e., perceived probability and perceived severity) and adaptation appraisal (i.e., perceived adaptation efficacy, self-efficacy and adaptation costs). Their analysis of two communities (one in Germany in which residents experienced frequent river flooding and another in Zimbabwe where crop farmers dealt with increasing drought) suggested that these capacities accounted for more variability in adaptive capacity and subsequent behavior change than socio-economic factors such as household wealth.

Formal education and adaptive capacity

A common way to estimate or measure the human capacity associated with Cinner et al.'s (2018) *learning* domain is through formal education experience (Cinner et al., 2018; Lutz & Kc, 2011; Scoones, 1998). While this approach has limitations due to inconsistencies in the quality and effectiveness of formal education systems (Kabeer, 2005), it remains one of the most widely used predictors of a variety of development outcomes such as reduced poverty, increased health, and improved quality of life (Jung & Thorbecke, 2003; KC & Lentzner, 2010; Psacharopoulos, 1994). For example, a study focused on adaptive capacities of rural communities in El Salvador and Brazil found that formal education experience increased participants adaptive capacity in four key ways: awareness and understanding of risk, access and use of information about risk, acceptance and use of this information pertaining to risk, and use of more effective coping strategies (Wamsler et al., 2012).

In a review of the literature evaluating the relationship between formal education experience and adaptive capacity to climate change related disasters, Muttarak and Lutz (2014) presented a framework organizing the impacts of education on adaptive capacity and

vulnerability reduction into direct or indirect effects. Direct effects included cognitive skills, problem solving skills, knowledge, and risk perception and were supported by studies at the scale of the individual (Ainuddin et al., 2014; Paul & Bhuiyan, 2010). Indirect effects of formal education included poverty reduction, access to information, and social capital, and were supported by studies at community and household scales (Crespo Cuaresma et al., 2013; Lutz et al., 2010; Rod'ríguez et al., 2007). Muttarak and Lutz's (2014) review provides a unique and useful framework as it highlights impact pathways at multiple scales, making it particularly relevant for studies focused on the adaptive capacity of individuals and households while also recognizing their nested location within larger societal groups and socio-cultural context.

An investigation into the influences of education on adaptive capacity is of particular relevance to our study region due to the previously documented impacts education seems to have on local livelihoods and culture (Bruyere et al., 2018, Van Anda et al., in review *a*). A study comparing visions of the future between pastoral young men and their school attending peers, suggests that young men with formal education experience have a preference for diversifying their livelihoods (Bruyere et al., 2018). Another study with pastoral youth in Samburu used a participatory, game-like scenario methodology to measure the perceptions and values of traditional pastoral livelihoods, indicating male and female students had strong preferences for destocking herds and diversifying incomes. This trend was particularly salient for students with more years of formal education (Van Anda et al., in review *a*). Both of these studies were conducted in the same region as our study and point to an influence of education on livelihood decisions, which in pastoral communities struggling with significant climate change impacts, may have some implications for adaptive capacity.

Gender, adaptive capacity and education

A gendered lens is critical to understanding and improving adaptive capacity at multiple scales. Women are significantly more vulnerable to climate change than men, which is often explained as a function of the gendered divisions of labor, access to financial and institutional resources, and access to information (Anbacha & Kjosavik, 2019; Kakota et al., 2011; Onwutuebe, 2019). Similarly, the impact of education on adaptive capacity also seems to be gendered. Muttark and Lutz's (2014) review of literature on education and adaptive capacity suggests that the positive impact of formal education on adaptive capacity is more significant for women than men. At a community scale, communities with higher mean years of schooling for women experienced lower mortality rates during natural disasters (Striessnig et al., 2013) and had better disaster preparedness (Muttarak & Pothisiri, 2013). At an individual scale, the results from the same study by Wamsler et al. (2012), indicated women with more formal education are less likely to experience health and social risks that limit adaptive capacity and are more likely to have access to assets that increase their adaptive capacity. These same relationships were not as clear for male participants.

The literature reviewed above underscores the importance of education as a viable determinant for adaptive capacity for women, particularly for enhancing skills in risk-assessment. However most of these studies are limited to analyses of the relationship between education and risk assessment, or between education and adaptive behavior (Grothmann & Patt, 2005; Muttarak & Lutz, 2014; Wamsler et al., 2012). They do not investigate decision-making processes that link risk assessment to adaptive behaviors. The purpose of this study is to explore the influence formal education experience may have on pastoral women's decision-making processes as they adapt to drought. We subsequently discuss the implications for utilizing formal

education as a strategy to support the climate change adaptive capacity of pastoral women in Samburu.

Methods

Study area: Waso East, Samburu, Kenya

Climate and ecology. Located in central Kenya, the Waso East district of southern Samburu is a semi-arid landscape and is approximately 4,950 km^2. Temperatures typically range between 18 to 30 degrees Celsius with an average annual rainfall of 350 mm in a bimodal precipitation pattern, peaking in April and November (Pas, 2018; Wittemyer, 2011). Arid and semi-arid regions in East Africa are often characterized by unpredictable precipitation; recent increases in drought frequency in the region is thought to be attributable to climate change (Opiyo et al., 2015; Ouma et al., 2018).

The region has been a priority for several conservation organizations and initiatives for several decades as issues such as invasive species (Kimiti et al., 2017), land fragmentation (Lesorogol & Boone, 2016) and intensified grazing of livestock are widespread and persistent (Vågen & Winowiecki, 2014). The impacts of these disturbances have been magnified by increased drought, resulting in a severely degraded landscape with significant consequences for wildlife and pastoral livelihoods (Ogutu et al., 2016).

Pastoralism and livelihoods. A community of approximately 7,000 people, the greater Archer's Post region is the largest settlement in Waso East (Kalama Community Conservancy, 2018). Historically transhumant pastoralist groups including the Samburu, Turkana, Rendille, and Borana tribes have called this region home for centuries. The Archer's Post community is predominantly Samburu. Households traditionally moved with their herds in search of pasture and water, relying solely on livestock and foraging for basic needs (Spencer, 1965). Both

colonial government policies and an increased desire for access to education, health care, and markets have resulted in a more sedentary lifestyle for many in the region today. While herding livestock continues to be a primary livelihood strategy, alternatives such as small business and tourism enterprises are increasingly common (Lenaiyasa et al., 2020).

Education. The greater Archer's Post community has experienced a recent increase in the number of children attending primary school, following government funding increases to provide (mostly) free primary education, and changing cultural norms that increasingly value formal education. However, secondary school is still cost-prohibitive for most families.

While education is seen both locally and nationally as an important long-term poverty alleviation strategy, it has had negative impacts on pastoral livelihoods and culture. In the recent past, school-age children were responsible for herding small livestock such as sheep and goats (i.e., shoats). Recent increases in school enrollment have largely shifted this responsibility to adult women. The need to access schools means the family is often split with some women remaining behind to take care of small livestock and children, while other family members migrate with larger livestock in search of pasture (Pickering, in preparation).

Gender. Gender, in addition to age, strongly influences community structure and decision-making in Samburu. Historically, women were responsible for domestic tasks such as cooking, cleaning, and fetching water and firewood. Women's responsibilities over livestock, specifically sheep and goats, have significantly increased (Pickering, in preparation). This increase in livestock responsibilities is occurring alongside increased access to education for girls (Syomwene & Kindiki, 2015) responsibility for alternative livelihoods (Ongoro & Ogara, 2012) and representation of women in local leadership (UNDP, 2017). Ongoing cultural practices and beliefs around polygamy, child marriage, female genital mutilation, domestic violence, and

property rights continue to limit the agency and well-being of women and underscore the dynamic and complex nature of gender in Samburu.

Participants and Sites

Participants in this study were adult women. Two villages were selected from the greater community, one located two kilometers from the Archer's Post town center, another located ten kilometers from the town center. These two villages were chosen to ensure participants represented diverse day-to-day experience within the larger community, such as varying access to pasture, water sources, clinics, schools and other resources. Participants' ages ranged from approximately 20 to 50 years of age.

Research ethics

Our research team included six members from the study region and three researchers from a university in the United States. Team members who led data collection were all local women from the participating communities. The local team played a significant role in designing, piloting, and facilitating the study. In addition to the research team, a group of local advisors provided guidance throughout the process.

We received permission to conduct the study from both Colorado State University Institutional Review Board, local elders and community leaders. Preliminary results were shared with participants via community meetings. Workshops with local organizations and leaders to further disseminate the results are anticipated for the future.

Sampling

Significant research has been conducted in the Waso East region in a variety of disciplines. Much of this research has been extractive (Van Anda et al., in review *b*) and as a result, many community members have negative associations with research and/or Western

researchers. We did not use random sampling out of respect for this history and the value Samburu culture places on relationship-building. Instead, our research team spent significant time with community members prior to designing the study and collecting data. We utilized a purposive sampling approach, ensuring our sample represented diverse age sets, formal education experience, socio-economic status, and geographic location.

Data Collection

Our method, entitled Participatory Adaptation Scenario and Mapping Activity (PASMA) is a novel approach created from a combination of participatory mapping (Sletto, 2009) and scenario planning methods (Peterson et al., 2003). We sought to design a participatory method that would generate data about the livestock-related decision-making processes women use when responding to drought, and the desired outcomes they hope to achieve. In addition, we aimed to design a method that was culturally appropriate and a rewarding experience for participants.

PASMA was conducted with groups of three to five women in similar age sets and formal education experience. Participants spent the first part of the activity looking at a satellite image of their community. A facilitator identified key landmarks, and women were given modelling clay and asked to work together to identify additional landmarks (see Figure 6). For many participants, this was their first experience looking at an aerial image of their landscape. The purpose of this activity was to familiarize participants with the map, to make the activity less abstract, and to create a comfortable, engaging environment. This portion of the activity took an average 30 to 45 minutes.

Figure 6. Image of map when participants were finished familiarizing themselves with the satellite image of their landscape

Once participants finished labeling landmarks, a facilitator explained the scenario-planning portion of the activity. As a group they were given hypothetical livestock and cash assets. Each participant group started the game with 20 shoats, and 6000 KSH (approximately 60 USD).

The activity consisted of three rounds, each simulating a different stage of drought. This simulation was based on local meteorological and climate data (see National Drought Management Authority Samburu County, 2018) and conversations our research team had with community members about the last major drought in 2017. After each round, participants were instructed to discuss and collectively decide what to do with their livestock, such as buy, sell or migrate. Decisions were played out by exchanging cash for livestock when buying/selling or moving livestock on the map to represent migration.

In round one, participants were told they were nearing the end of what should have been the first rainy season of the year, but there had been little to no rain. Their herd had given birth to a small number of shoats, and the market value of an adult shoat was 3000 KSH. Participants were instructed to discuss and decide collectively what to do with their livestock.

Round two simulated a full year into the drought, still with no significant rains. The market value of shoats dropped by 33%, and 12% of the herd died due to lack of forage and water. Again, participants were asked to discuss and decide what to do.

Finally, round three simulated the rain returning and market prices of shoats increased by 50%. The game concluded with a group discussion about what participants would do with their herd and cash at the end of the activity, as well as a discussion about what they might do if they were to participate in the activity for a second time.

The activity was facilitated in the *Samburu* dialect of Maa and the facilitator explained instructions for each round of the activity. Additionally, a notetaker used a standardized score sheet to track decisions made in each round. Photos were taken of the map after each round (see Figure 7), and the activity was audio recorded.

Figure 7. Photo of map taken during the drought scenario portion of PASMA

Prior to data collection, the research team piloted different variations of the activity many times with different groups of women, ensuring the game was engaging, clear, and as realistic as possible.

PASMA was conducted with 14 groups, with a total of 54 participants. Seven of the 14 groups were conducted with participants with formal education with a mean of 7.88 years of education experience while the other seven groups were conducted with participants without formal education. Fifty-seven percent (57%) of participants were between the ages of 20 and 35 while 43% of participants were between the ages of 35 and 50. Seventy percent (70%) of participants stated that their households currently engaged in pastoralism as a livelihood

Data Analysis

Audio recordings of the activity were transcribed and then translated into English. This process was completed twice, by two different translators for each transcript. Score sheets were compared to transcripts to check for accuracy.

Decision outcomes were compiled into a quantitative data sheet that included variables for number of shoats, amount of cash, total assets, and distance migrated for each round in addition to final net profit and final net shoats. Independent t-tests and Wilcoxon Rank Sum Tests for non-parametric variables were used to compare data across groups based on formal education experience. The quantitative analysis was conducted using R statistical software.

Braun and Clark's (2006) protocol was utilized for a thematic analysis of the transcripts to understand the factors that women considered during their decision-making process. Data was reviewed several times before generating initial codes. After initial coding, codes were organized into themes and subsequently reviewed and described. A comparative analysis as outlined by Bazely (2013) was conducted to compare differences in how participants with formal education and participants with no formal education discussed each theme. The qualitative analysis was conducted using NVivo software.

Results

Quantitative Analysis

We compared quantitative variables that represented decision-making outcomes (e.g., number of livestock, amount of cash, total assets, distance migrated, net profit) between participants with formal education and no formal education. Independent t-tests were used to compare parametric data (see Table 2) and Wilcoxon Rank Sum Tests were used to compare non-parametric data (see Table 3).

Quantitative outcomes in rounds one and two of the activity were not significantly different between the two groups. However, outcomes from round three were significantly different ($p < 0.05$). The formal education group had a significantly higher proportion of their assets in cash and the group without formal education had significantly larger herd sizes.

Additionally, the formal education group finished the game with a significantly higher net change in herd size by selling more shoats in comparison to the group without formal education.

Table 2. Wilcoxon Rank Sum Test results for nonparametric data

Independent Variable	*Formal Education Median*	*No Formal Education Median*	*W*	*p-value*	*r*
End of Round 1 – Money (KSH)	15000.00	12000.00	20.50	0.65	-0.12
End of Round 1 – Herd size (# shoats)	22.00	23.00	28.50	0.65	-0.12
End of Round 1 – Distance migrated (km from village)	0.00	9.10	32.50	0.29	-0.28
End of Round 2 – Money (KSH)	20000.00	16000.00	18.50	0.48	-0.19
End of Round 2 – Assets (KSH)	5300.00	5200.00	22.50	0.85	-0.05
End of Round 2 – Herd size (# shoats)	15.00	17.00	31.00	0.44	-0.21
End of Round 2 – Distance migrated (km from round 1 location)	16.88	12.59	19.50	0.56	-0.15
End of Round 3- Herd size (# shoats)	17.00	20.00	41.00	0.04	-0.55
End of Round 3 – Distance migrated (Km from round 2 locations)	12.59	13.52	32.00	0.37	-0.24

Final - Total Distance (km from round 1 + round 2 + round 3)	34.26	30.55	27.00	0.80	-0.07

Table 3. Independent T-test results for parametric data

Independent Variable	*Formal Education Mean*	*No Formal Education Mean*	*df*	*t-statistic*	*p-value*	*Cohen's D*
Round 3 - Money (KSH)	19142.86	6857.14	11.17	-2.38	0.04	1.27
Round 3 - Assets (KSH)	84285.71	86285.71	9.72	0.57	0.58	0.31
Final net Profit	3285.71	5285.71	9.72	0.57	0.52	0.31
Net herd size	-5.71	-2.14	10.34	2.65	0.02	0.31

Qualitative Analysis

Our thematic analysis of the transcripts resulted in ten major themes representing the issues that participants discussed while making decisions about their livestock. In the following paragraphs we describe these themes and compare the ways in which the two groups emphasized and contextualized each theme.

Climate. Factors such as rain and temperature were discussed in reference to forage availability and precipitation patterns. The occurrence of rain encouraged buying and discouraged selling of shoats. This theme was often contextualized by the market value of livestock, as the prices fluctuated with the rains and the subsequent impact on livestock health. Some women expressed their faith that God would send the rain as a reason not to sell livestock

when discussing concerns over livestock loss during the drought. In one conversation, a participant expressed a fear of livestock death and a need to sell: *"We need to sell, they will die,"* but another participant in the conversation disagreed: *"We are not selling because God will send the rain and then we go and buy mor*e."

Women with formal education discussed the temporal patterns of rain as an indicator of when to buy and sell, frequently in the context of fluctuating market prices. Women without formal education also discussed buying and selling patterns, in addition to when to migrate with their livestock.

Herd characteristics. Participants repeatedly emphasized the importance of physical characteristics of shoats when making decisions about whether to sell, buy, or migrate livestock. These characteristics were discussed in four distinctive ways. First, participants highlighted the age of livestock as a key factor in deciding which ones to sell and buy; older animals to sell and younger animals to buy. Younger animals were considered more drought resistant than older livestock, with the exception of newborns. *"Yes, sell the old shoats because now we have knowledge about the drought. Now let's go back to our livestock and select the old ones and sell and leave the young ones because drought doesn't kill the young ones.*" Similarly, the sex of the animal determined the likelihood of selling or buying; male animals were sold, while female animals were kept because of their reproductive potential. In a similar vein, the reproduction cycle of female animals was an important indicator of when to sell, buy, and migrate. Finally, one of the most important characteristics was the species of livestock. Goats were considered more drought resistant than sheep, and participants emphasized the importance of *swapping* livestock at the market and with neighbors to change herd composition.

Overall, there was very little difference in the context and meaning of *herd characteristics* between the two groups.

Livestock health. The health of individual livestock was considered an important factor for a variety of decisions. It was both a reason not to migrate, because unwell livestock might die on the journey, and a reason to migrate, because livestock would get too weak with no pasture or water available if the herd remained near the settlement. Livestock health was discussed both in the context of drought impacts (e.g., weakness from lack of food and water) and in the context of the rainy season, when many diseases become common.

Both participant groups placed significant value on the health of their livestock, but the group with formal education emphasized the risk of livestock illness and the importance of preventing illness in their discussions. The group with no formal education emphasized the importance of waiting until livestock were big and healthy before selling in order to get the best price at market. *"Let us not sell yet. Let us leave these goats of ours so that they can grow big and become healthy and when it rains, then we will sell later."*

Supplementary feeding. Supplementary feeding was described as a strategy for keeping livestock healthy, or even increasing herd size during a drought: "*I told you, we will buy two shoats and bring them into our livestock. Then we get the leaves of the loyeti tree, that way we can keep them big and strong."* It was also discussed as a strategy for keeping livestock close to home and not having to migrate as far. Preferences for supplementary feeding influenced decisions to sell livestock, and to pay for the cost of the food when natural foraging was not possible or practical. There was no meaningful difference in the way the two groups discussed supplementary feeding.

Access to veterinary medicine. Accessing veterinary medicine was a common reason for selling a small number of shoats, creating a feedback loop between increasing herd size and having to sell more livestock to keep them healthy. Veterinary medicine was viewed as both a proactive and reactive strategy, with many participants indicating the importance of vaccinating and providing care to livestock to avoid disease. There was no difference in how the two participant groups discussed the access to veterinary medicine.

Need to restock. Discussions about the *need to restock* livestock after the drought occurred in the context of both selling livestock in the early warning stage of the drought and buying livestock once the rains returned. Participants described restocking as a way to reassure each other when making the decision to sell and as an important way to recover post drought. *"We will sell now, but when the rain comes back, we take that money to buy shoats again".*

The group with formal education focused the conversation of restocking around the goal of replacing lost livestock (lost either due to selling or livestock mortality from drought), while women in the group without formal education discussed restocking as a strategy to both replace lost livestock as well as increasing their herd beyond their pre-drought herd sizes.

Market value of livestock. The *market value of livestock* was an important consideration when deciding to buy and sell livestock. Participants discussed barriers associated with fluctuating market prices: sometimes demand was too low and made leveraging livestock assets into usable cash very difficult. Participants associated fluctuations in market prices with shifts in the climate and health of the livestock.

Need for cash. The *need for cash* was also an important factor and was explicitly discussed as the main driver for selling livestock. Participants expressed a growing need for cash, particularly for buying food, veterinary medicine, paying school fees, and accumulating savings.

"We need to sell five, so that we can buy medicine (for shoats), and at the same time we'll buy food. We sell, and then we put the remainder in the bank." Some participants indicated they would only sell the number of livestock required to pay for food, medicine, and school fees while other participants explained that keeping some cash in a bank account was also important for emergencies. There was no meaningful difference in how the two groups discussed this theme.

Children's access to education. Children's access to education was an important priority, discussed in the context of both selling livestock to pay for school fees, and altering migration plans. For example, women negotiated how far to migrate and who would do the herding based on their responsibilities as mothers. All participants talked about the importance of working collaboratively by separating and sharing livestock and domestic responsibilities so children could stay in school and livestock would access good pasture. *"One of us needs to be at home to look after the kids. Because we are a group, the others can go with the livestock."* They also talked about their growing responsibilities as herders as a direct result of having their children in school.

Participants with formal education focused their conversations about school on the need for collaboration between women, and as a driver for selling livestock. Participants with no formal education also prioritized having their children in school, and further lamented about how keeping children in school made responding to the drought more difficult. Being able to move longer distances was a critical aspect in their ability to cope with drought but keeping their children in school meant either keeping the livestock close to home, or having some women stay away from their families, children, and support network for significant periods of time.

Alternative livelihoods. Alternative livelihoods were discussed as less susceptible than herding livestock to the impacts of drought, and also as a reason to sell livestock, to invest that

capital in another way for making income. *"My people, how do we have to keep the livestock? I think it's better we do a merry-go-round (an informal savings system) for us to do a business before the drought comes".*

Common examples of alternative livelihoods included owning small shops, doing laundry at a local military base, and collecting and selling firewood or charcoal. However, alternative livelihoods were discussed as temporary and in addition to pastoralism, rather than permanently replacing livestock rearing.

Similar to children's access to education, the group with no formal education also described alternative livelihoods as a barrier to migration requiring collaboration between women. Non-pastoral livelihoods often rely on proximity to other people and more permanent settlements, requiring someone to stay home and look after the alternative livelihoods while other women herd livestock.

Discussion

Influence of formal education: Increased risk assessment and ecosystem health

Our results suggest that participant groups made different decisions as they reacted to the drought scenarios during the activity, but only once they lost livestock to drought. The formal education group restocked their herds following drought at significantly lower rates and finished the game with a greater portion of assets in cash. This tendency of those with formal education to divert assets away from livestock are supported by the results of two additional studies conducted in the same community with youth (Bruyere et al., 2018; Van Anda et al., in review, *a*).

The difference in net herd size and cash assets between the two groups at the end of the game could be a result of a difference in the learning component of adaptive capacity,

specifically, a difference in risk assessment. This interpretation is supported by previous literature and our qualitative analysis. Studies suggest formal education experience is directly linked to acquiring skills and knowledge that lead to higher risk awareness (Ainuddin et al., 2014; Muttarak & Lutz, 2014; Wamsler et al., 2012) and greater likelihood of engaging in behaviors to reduce risk (Paul & Bhuiyan, 2010). Additionally, our comparative analysis of the participants' decision-making discussions indicates a meaningful difference in the way groups discussed the market value of livestock and livestock health. While the market value of livestock was salient for both groups, the group without formal education put a particular emphasis on their concerns of selling their livestock at too low a price, often opting to retain livestock at multiple points during the activity no matter the circumstance. Similarly, this group also discussed the health of livestock in the context of waiting to sell until livestock were healthy so they could get a higher price at market. In contrast, the group with formal education expressed concerns about livestock becoming unwell before or during migration and fear of livestock becoming unwell before they were sold. These differences in the way groups gave meaning to the market value of livestock and the health of livestock can be interpreted as differences in risk assessment, with the group with formal education seemingly more risk-aware and, potentially risk-averse, in both contexts. As a result, by the third round of the game, after they had just previously experienced livestock loss due to drought, the group with formal education restocked at a lower rate and kept a greater proportion of their assets in cash to avoid further livestock loss, potentially better prepared to respond to negative impacts of a future drought.

Ultimately, our results support previous literature, indicating formal education influences adaptive capacity by increasing risk-assessment, a component of Cinner et al.'s (2018) *learning domain* of adaptive capacity. However, it should be noted that our results could also be explained

in part, by the role that education has in shifting cultural values. Studies conducted in the region indicate that owning livestock remains a critical part of Samburu identity, but the value of non-pastoral livelihoods seems to be greater for community members who have attended school (Bruyere et al., 2018; Bruyere et al., 2020). As a result, the lower restocking rate post drought by the formal education group might in fact be explained by a complex relationship between increasing access to education and shifting cultural values.

In addition to highlighting education's influence on adaptive capacity for pastoral women, the lower restocking rate of the formal education group could also have implications for rangeland management and ecosystem health. In a community where the percentage of pastoral youth enrolled in school is growing, a potential reduction in herd size at a significant scale could potentially have positive ecological impacts. The local ecosystem already suffers from degradation in part due to overgrazing (Pricope et al., 2013; Vågen & Winowiecki, 2014). We do not know if a reduction in the number of livestock on the landscape would be enough to rebuild the health and resilience of a rangeland struggling with a variety of degradation drivers. However, research in the area suggests that reduced grazing pressure during key times when vegetation and wildlife are recovering from drought is essential for the viability of current and future restoration efforts (Odadi et al., 2017).

Influence of formal education: Not a silver bullet

Education access, particularly for women, is frequently lauded as a silver bullet to many socio-ecological problems (Sachs, 2012, UNESCO, 2016). As a result, education and development advocates would expect to see substantial differences between our participant groups. Conversely, there is also literature that suggests that traditional ecological knowledge of individuals who have spent more time on the rangeland is likely much higher than their formally

educated counterparts and might actually lead to better information and knowledge relevant to adaptive capacity (Aswani et al., 2018; McCarter & Gavin, 2011). Regardless, we expected to see significant differences in the way the two groups utilized past experiences and information. Our results highlight the role education experience may have played as participant groups adapted to drought impacts at the conclusion of the activity. However, they also highlight lack of influence formal education experience had as participants reacted to the warning signs of drought. While these results do not necessarily contradict previous literature, they suggest a more complicated relationship.

The marginal influence formal education seemed to have on the decisions participants made in the beginning and middle of the activity could be explained by systemic issues associated with the formal education system. First, while Kenya has made significant strides in improving the quality of education across the country in the recent past, the national education system, due to its origins in colonialism, is criticized for reinforcing Western-based pedagogy (Woolman, 2001) and failing to recognize the importance of place-based inclusion of local Indigenous knowledge (Ng'asike, 2014; Wane, 2008). This is particularly salient for tribes (e.g. Samburu) who, as pastoralists, are largely considered to be one of the most marginalized cultural groups, particularly at a national policy level (Jordt Jørgensen, 2013; Ogachi, 2011; Pavanello, 2009). The education system simply does not address, and is not designed to address, the complex, place-based and culturally specific problem solving needed for Samburu to navigate a changing climate and maintain a sustainable pastoral livelihood.

If the education system is not designed to support pastoralists as they adapt to climate change, the marginalization of pastoral women is likely to be further exacerbated. Institutional systems frequently reinforce the inequities that already exist in society, rather than deconstruct

them (Amis et al., 2018). Studies using a gendered lens analyzing education systems in sub-Saharan African countries such as Kenya, find that many of these education systems reinforce gender stereotypes, promoting women's value as largely dependent on their roles as wives and mothers (Chege & Sifuna, 2006; Lesorogol, 2008). While the skills and knowledge promoted via formal education may be theoretically advantageous for adaptive capacity, the gender stereotypes reinforced by the education system, when applied in places like Samburu, often result in women experiencing very little opportunity to practice and retain the skills and information gained in school (Lesorogol, 2008). These impacts, in combination with an education system not actually designed to provide pastoral students with the skills and information needed to adapt to a changing climate, create significant barriers that might explain why formal education did not seem to substantially impact how participants made decisions in the activity.

Implications for theory and practice

Previous literature makes a convincing argument that formal education access has the potential to increase adaptive capacity. While some of the results from this study support this claim, our results also highlight the complexity of this relationship. Cinner et al.'s (2018) five domain theory of adaptive capacity provides a potential framework for understanding this complexity. The differences between participant groups in our results (restocking rates and proportion of assets in cash post drought) point to a difference in risk assessment, potentially driven by greater risk awareness amongst the formally educated participant group. These results highlight the influence education experience might have on increasing the *learning* component of adaptive capacity. However, our results also illustrate little substantial difference between participant groups' decision-making in almost every other aspect of the activity. This could

potentially be explained by an education system that was never designed to provide pastoralists with relevant skills and information and reinforces gender roles and stereotypes.

In addition to *learning*, (and s*ocial organization, flexibility* and *assets*) Cinner et al. (2018) include *agency* as an important domain of adaptive capacity. In their paper, they suggested "incorporating local or customary knowledge, skills and management" and "removing barriers that may inhibit people's ability to exercise agency" are important actions for improving the *agency* domain of adaptive capacity (pp. 120, 2018). Both of these suggestions have important implications for increasing the impact formal education could have on adaptive capacity. "Incorporating local knowledge" means designing education curricula to be more inclusive and relevant to pastoral livelihoods and the climate change stresses they experience. "Removing barriers to agency" can be translated into ensuring education systems deconstruct harmful gender stereotypes that limit pastoral women's agency rather than reinforce them. In order to be a more effective strategy for increasing the adaptive capacity for pastoral women, education must aim to influence more than the *learning domain* of adaptive capacity, but also recognize the critical need for addressing the *agency domain.*

It is well documented that education is an important component of supporting the well-being and resilience of communities, particularly for women. The results of our study suggest formal education may positively influence the *learning* component of adaptive capacity for Samburu women practicing pastoralism. However, reforms to education policy and practice need to be made in order to more effectively capitalize on the potential formal education has to support pastoral women's adaptive capacity as they experience the increasing pressures of climate change. While the specifics of these reforms need extensive further study, using Cinner et al.'s (2018) five dimensions of adaptive capacity provides some guidance for this reform.

Education systems must be designed to do more than just increase an individual's ability to absorb and process new relevant information. They need to support the agency of pastoral women by including place-based and locally relevant curricula and deconstructing, rather than reinforcing, harmful gender stereotypes.

CHAPTER 4: THE INFLUENCE OF PASTORAL COPING AND ADAPTATION STRATEGIES ON SAMBURU WOMEN'S WELL-BEING: THE GENDERED NATURE OF CLIMATE CHANGE

Chapter Summary

Pastoral women in the semi-arid rangelands of East Africa carry significant weight of increasing vulnerability to and responsibility for responding to drought. As a result, understanding how pastoral households are responding to drought via both adaptation and coping strategies, and the subsequent impacts for women, is critical for supporting the climate resilience of pastoral communities. Using a household survey and a multi-dimensional framework of well-being, this study investigates how the use of drought-related coping and adaptation strategies by Samburu households influences both livestock loss and women's well-being in northern Kenya. Our results indicate that coping and adaptation strategies predicted various social-cognitive components of well-being, but not livestock loss, which we explain via gender roles associated with specific response strategies. We discuss implications for both theory and practice, arguing that interventions aimed at supporting the drought resilience of pastoral women must critically consider the gendered implications of various response strategies, multiple-indicators for evaluation, and the significant influence of community and place.

Introduction

A small number of developed countries are responsible for the majority of CO_2 emissions driving the global climate crisis (International Energy Agency, 2018). At the same time, developing countries who are least responsible for CO_2 emissions are affected greatly by the impacts (Althor et al., 2016), particularly communities whose livelihoods are heavily and

directly reliant on natural resources (Thomas & Twyman, 2005). As a result, supporting climate resilience in these communities is a critical priority for interventions aimed at equitably addressing the climate crisis. Pastoral communities in the semi-arid regions of East Africa are one such group facing intense climate change impacts (Field, 2014) yet carry little to no responsibility for the current climate crisis. Pastoral women are at the very center of this inequitable paradox, as they shoulder a significant portion of the burden of responding to climate change (Anbacha & Kjosavik, 2019b; Balehey et al., 2018) and simultaneously face gendered barriers that make doing so difficult (Anbacha & Kjosavik, 2019a; Balehey et al., 2018; Venkatasubramanian & Ramnarain, 2018). Understanding how pastoral households respond to drought, and the gendered impact of these responses, is critical for identifying potential strategies and interventions aimed at supporting the climate resilience of pastoral women and their communities.

Pastoral drought response

Pastoralism is a livelihood strategy dependent on the raising of livestock, and in most pastoral societies, livestock have significant cultural value in addition to the role they play in achieving income and food security (Dyson-Hudson & Dyson-Hudson, 1980). In the arid and semi-arid landscapes (ASAL) of East Africa, the increasing occurrence of drought due to climate change has created "scarce, scattered and unpredictable pasture and water points," (Hesse & Cotula, 2006, p. 2) with significant negative consequences for the pastoral communities situated in these landscapes.

Traditionally, pastoralists have relied on mobility as their primary strategy for responding to drought (Dyson-Hudson & Dyson-Hudson, 1980; Krätli et al., 2013). However, recent institutional and socio-economic trends such as land privatization, insecurity and anti-pastoral

government policies, undermine pastoral grazing rights and limit mobility (Behnke et al., 2020; Dabasso et al., 2019; Goldman & Riosmena, 2013). Subsequently, pastoralists have begun to rely on other strategies such as diversifying livelihoods (Achiba, 2018; López-i-Gelats et al., 2015), importing fodder (Opiyo et al., 2015; Speranza, 2010), and changing herd composition (Opiyo et al., 2015; Wako et al., 2017) to better respond to drought. However, factors such as access to credit, formal education, gender, age, wealth, and geographic location are important determinants of whether a household is able to adopt specific response strategies (King et al., 2018; Opiyo et al., 2014).

A significant portion of the literature exploring community and household response strategies to climate change categorizes such responses as either *coping* or *adaptation* (Alemayehu & Bewket, 2017; Azumah et al., 2017; Eriksen & Kelly, 2007). This categorization is particularly salient in the literature focused on pastoral livelihoods (see Morton, 2007; Opiyo et al., 2015; Speranza, 2010; Venkatasubramanian & Ramnarain, 2018). *Coping strategies* can be defined as temporary adjustments that tend to be reactive and aimed at restoring or maintaining a previous state (Opiyo et al. 2015; Eriksen & Kelly, 2007; Venkatasubramanian & Ramnarain, 2018). *Adaptation strategies,* on the other hand, are long-term proactive adjustments to current and future stressors (Opiyo et al. 2015; Erikson & Kelly, 2007; Venkatasubramanian & Ramnarain, 2018; Nelson et al., 2007). Morton (2007) stresses the distinct difference between coping and adaptation: adaptation strategies reduce overall vulnerability to climate shocks while coping strategies manage and reduce the impact of shocks which are already occurring. Studies have applied this coping and adaptation framework by categorizing response strategies such as changing herd size numbers, increased reliance on bush products, and additional fodder as coping strategies, while categorizing livelihood diversification, livestock grazing regimes, and

changes to herd composition as adaptation strategies (Opiyo et al, 2015, Venkatasubramanian Ramnarain, 2018). Furthermore, the results from these studies highlight the complexity of studying coping and adaptation strategies, as evidence suggests that many pastoral households engage in both types of strategies simultaneously (Venkatasubramanian & Ramnarain, 2018; Opiyo et al., 2015).

With the exception of Venkatasubramanian and Ramnarain (2018) qualitative study, few scholars have focused on the gendered implications of coping and adaptation strategies, specifically on the unique experiences of pastoral women as they engage in these strategies. However, several studies have investigated how climate change impacts, specifically drought, uniquely affects pastoral women (Anbacha & Kjosavik, 2019b; Omolo & Mafongoya, 2019; Ongoro & Ogara, 2012). Pastoral women in East Africa face "double marginalization" due to the intersection of their identities as *women* and *pastoralists.* This marginalization influences their vulnerability to climate change, capacity to respond, and the impacts of those responses (Balehey et al., 2018; Eneyew & Mengistu, 2013; Ongoro & Ogara, 2012). More specifically, gendered marginalization limits pastoral women's ability to own land and livestock, access formal education, and acquire non-pastoral employment, all of which increase an individual's capacity to cope or adapt to climate stressors (Gurmu, 2018). Women's limited access to these opportunities is intensified by the increase in "women's work" associated with climate shocks. Tasks such as collecting water and firewood, taking care of sick livestock, and herding small livestock become increasingly labor intensive during a drought (Westervelt, 2018). While this literature documents gendered differences in the impacts of and capacities critical for responding to climate change, there remains a significant gap in our understanding of how gender interacts

with specific response strategies. This study seeks to fill this gap by centering the perspective of pastoral women as we investigate the impacts of coping and adaptation strategies.

Conceptual framework

In both the theoretical and applied literature focused on the resilience of pastoral communities, the impact of drought is frequently measured by livestock loss (see Goldman & Riosmena, 2013; Nkedianye et al., 2011). While livestock numbers are an obvious and relevant indicator, these numbers tell an incomplete narrative of communities' experience with drought. Social-ecological systems theory defines resilience as the capacity of a system to tolerate disturbance without collapsing into a qualitatively different state (adapted from Adger, 2000; Berkes & Folke, 1998; Gunderson, 2000; Holling, 1973). Resilience theory provides a more holistic understanding of the impacts on and responses by social-ecological systems to drought and has become an increasingly important construct in the context of climate change (Bahadur et al., 2010; Cumming & Allen, 2017). Proponents of resilience theory argue for its utility in looking beyond the immediate impact of a disturbance (e.g., livestock loss), to include the processes actors within a system use to respond to a disturbance (Berkes, 2017; Sellberg et al., 2018). Scholars have further argued that resilience should not be the ultimate goal of interventions but rather an intermediate step to achieving more long-term goals such as well-being (Armitage et al., 2012; Béné et al., 2012, 2015).

The body of literature focused on concepts of well-being emerged primarily from the disciplines of psychology and international development (Gough & McGregor, 2007). In psychology, well-being developed away from deficit models to asset-based models of understanding human nature, focusing on concepts such as motivation, happiness and purpose in life (Maslow, 1943; Seligman & Csikszentmihalyi, 2000). In international development, well-

being concepts emerged as a counter to purely economic understandings of poverty and instead focus on what it means for people around the world to "live well" (Gough & McGregor, 2007). Across disciplines, there is general consensus that a holistic understanding of well-being needs to consist of both the objective circumstances of a person and their subjective evaluation of these (Gough et al., 2007).

Growing international concern around issues such as environmental justice has increased the demand for understanding and using well-being to evaluate the social impacts of ecological disturbances and associated interventions (Woodhouse et al., 2015). To address environmental contexts, the Economic and Social Research Council's Working Group on Well-being in Developing Countries (WeD) developed a multi-dimensional well-being framework. The framework is based on the following definition: well-being is the "*state of being with others and the natural environment that arises where human needs are met, where individuals and groups can act meaningfully to pursue their goals, and where they are satisfied with their way of life*" (Armitage et al., 2012; adpapted from McGregor, 2008). In addition, the WeD framework posits that well-being is comprised of three dimensions: (1) what a person has (material), (2) what they can do with what they have (relational), and (3) how they think about what they have and can do (subjective) (McGregor and Gough, 2007). While the WeD framework has been applied in contexts where community livelihoods are highly dependent on natural resources (Britton & Coulthard, 2013; Milner-Gulland et al., 2014), it has yet to be applied to investigate drought impacts and response strategies of pastoral communities. In this study, we used the WeD framework to guide our investigation of how households' use of coping and adaptation strategies in response to drought, impact pastoral women's well-being. We also investigate differences between livestock loss and socio-cognitive well-being as indicators of drought impact.

Methods

Study area

Climate and ecology. The semi-arid landscape of the Waso East district of Samburu County, Kenya, is approximately 4,950 km^2. The climate is characterized by a bimodal precipitation pattern, with a cumulative average annual rainfall of 350 mm and temperatures typically ranging from 18 to 30 degrees Celsius. Recent increases in unpredictable precipitation patterns, specifically drought, are more frequent and thought to be a result of climate change (Opiyo et al., 2014; Ouma et al., 2018).

In addition to shifts in climate, the regional landscape is experiencing several ecological threats including invasive species (Kimiti et al., 2017), land fragmentation (Lesorogol & Boone, 2016), and intensified grazing of livestock (Vågen & Winowiecki, 2014). The interaction between these ecological disturbances and the impacts of climate change have resulted in decreased primary productivity of the landscape and its rangelands, ultimately increasing the vulnerability of local pastoral livelihoods, as well as local flora and fauna (Ogutu et al., 2016).

Pastoralism and changing livelihoods. The greater Archer's Post community is the largest permanent settlement in Waso East, and home to approximately 6,000 people (Samburu County Government, 2020). Historically, transhumant pastoral groups including the Samburu migrated across this region in search of water and pasture (Spencer, 1965). However, the interaction of broad drivers including but not limited to colonialism, globalization, and post-colonial government policies have resulted in a shift toward more sedentary communities. As a result, alternative livelihoods such as small business and tourism enterprises have become increasingly common (Lenaiyasa et al., 2020). Despite these shifts, livestock and livestock-related livelihoods remain a primary livelihood strategy for many households in the area (Lenaiyasa et al., 2020).

Gender. The structure of Samburu communities is strongly influenced by gender and age. Traditionally, older men were considered community-decision makers, younger men were responsible for security and livestock, and women were responsible for domestic tasks such as caretaking, cooking, cleaning, and fetching water and firewood (Holtzman, 1996; Spencer, 1965). However, changes in culture and livelihood practices have shifted these roles, one of the most notable being the role and responsibilities of Samburu women. Examples of the shifting roles of women include increasing responsibilities for small scale livestock, non-livestock related livelihood activities, and enrollment of children in school.

In addition, young men responsible for herding livestock are forced to move further away and for longer periods of time in search of healthy pasture for livestock, especially cattle. Simultaneously, sheep and goat husbandry have increased, and available herding labour has decreased as more children attend school. Subsequently, women's livestock-related responsibilities have increased dramatically (Pickering et al., in preparation). These responsibilities have become more burdensome as quality pasture near settled areas has decreased.

The increase in women's livestock responsibilities has occurred alongside dynamic cultural practices and beliefs around polygamy, child marriage, female genital mutilation, domestic violence, and property rights that continue to limit the agency and well-being of women (Graamans et al., 2019; Mwakio, 2017). These practices of gender marginalization are occurring at the same time as pastoral women and girls are experiencing increased access to education (Syomwene & Kindiki, 2015), improved agency over alternative livelihoods (Ongoro & Ogara, 2012), and increased representation in political leadership (UNDP, 2017*).* Samburu

women are experiencing slow but important gains in gender equity, yet still experience gender-based barriers that limit opportunities to take advantage of such gains.

Research Ethics

Permission to conduct this research was provided by local elders and community leaders, in addition to the Institutional Review Board at Colorado State University (ID: 18-7927H). We followed a community-based approach in which our research question was based on exploratory interviews with community members to determine local priorities for research. Data for this study were collected by female team members from the local area, and the study design and implications of the results were developed collaboratively with the local research team. Preliminary results were presented to study participants during several community meetings. Workshops with community organizations to discuss the local implications of the research are intended to take place following the COVID-19 global pandemic.

Data Collection

Data were collected via a household survey in two communities within the greater Archer's Post community. The selected communities were specifically chosen because they represent a significant contrast in pastoral practices and lifestyle. Community A is located approximately three kilometers from Archer's Post town center and home to ~500 households. Community B is approximately 15 kilometers from Archer's Post town center and home to ~240 households. Comparatively, community A has significantly easier access to basic services (e.g. healthcare, schools, livestock markets) than community B. However, community B is home to larger livestock herds, has access to more unrestricted acreage for grazing, and members tend to practice a more traditional pastoral way of life, all of which can lead to differences between the

communities including but not limited to, gender roles, formal education rates, and migration patterns (Northern Rangelands Trust, 2016).

The survey was administered face to face between October and December of 2019 in the Samburu dialect of Maa. Respondents were often completing sedentary tasks such as beading and treating livestock hides while participating in the survey. Our research team visited all villages in each community [nine villages in community A (n=125 households), six in community B (n=75)] at least five times, often in the afternoon to avoid missing women who would commonly be away from home when collecting water and firewood in the morning. We also visited in the evening to provide opportunities for women to participate who were out with livestock during the day. When arriving at each village, we explained the purpose of the survey and invited one woman from each household (over the age of 18) to participate.

Survey instrument. The survey was comprised of three sections each with a specific focus: demographics, participants' current ratings of well-being, and the impact and response to a severe drought in 2017. The survey was created by our team and based on previous work investigating Samburu women's well-being (see manuscript 2) and the impacts of the 2017 drought (see Pickering et al., in preparation). The survey was originally written in English and then translated into the Samburu dialect of Maa by our local team members. Once translated, the survey was piloted (n = 40) and minor adjustments were made. Local team members facilitated administration of the survey. The questions on the survey were translated and written in the local language, facilitators read the questions aloud to participants, and captured the responses on a tablet. The survey software was programmed with both Maa and English translations of all survey questions and responses to allow the non-local members of our team to review the data in English.

Outcome variables. We asked women specifically about the number of shoats (sheep and goats) lost to the 2017 drought because women typically have an accurate recollection of shoat loss, based on their livestock responsibilities. We converted these numbers into a percentage loss for each household.

In addition to livestock loss, we also asked questions about present-day well-being (approximately 1.5 – 2 years after the last major drought). The well-being indicators used in the survey were based on previous work in the community to establish a culturally relevant and gender-specific framework for well-being (see manuscript 1). This framework applies the WeD well-being framework (Gough & McGregor, 2007) and delineates three dimensions of wellbeing: material, relational, and subjective. We chose one tangible indicator from each dimension based on themes that women from Samburu highlighted as particularly important, in previous research (see manuscript 1). From the material dimension, we asked women about their food security, specifically asking how many meals they had skipped in the last month due to a lack of food. For the relational dimension, we asked women about their ability to provide for their children, measured on a Likert scale of (1 = not at all, 5 = very much). From the subjective dimension, we asked women about their hope for the future, also measured on a Likert scale (1 = not all, 5 = very much).

Previous literature has shown that traditional Likert scales can be difficult to use in populations with low literacy rates and across cultures (Flaskerud, 1988; D'Alonzo, 2011). To address this issue, participants were asked to respond to Likert-type questions using an image of a bar graph. Facilitators explained that the smallest bar represented "not at all" and the largest bar represented "very much." Each bar in-between was described using a different Maa word that represented the spectrum of responses in between "not at all" and "very much". Participants

were asked to place a rock on the bar that represented their answer. To familiarize participants with this system and increase the accuracy of their responses, each participant practiced using the bar graph by answering questions like “how tired are you right now?”.

Key predictor variables. Key predicter variables included the number of *coping* strategies and the number of *adaptation* strategies each household used in response to the 2017 drought. Participants were asked if they engaged in any one of nine total strategies. This list of strategies was created based on preliminary interview data with women in the area, colleagues’ prior research in the area, and previous literature (e.g. Ongoro & Ogara, 2012; Opiyo et al., 2015). We classified strategies as either *coping* or *adapting* by using the definitions outlined previously in the literature review (Eriksen & Kelly, 2007; Nelson et al., 2007; Opiyo et al., 2015; Venkatasubramanian & Ramnarain, 2018). Migration via walking, migration via truck, and supplementary feeding were all categorized as coping strategies because they all respond to the immediate threat of drought and mitigate rather than directly reduce the vulnerability to future droughts. Selling and buying livestock were also categorized as coping strategies, because according to interviews and previous research in the community (see manuscript 2), changes in herd size (particularly the selling of livestock) is often a reactionary, temporary strategy with households returning to typical herd size once they can afford to do so. Livelihood diversification, on the other hand, represents an investment in a different method of making a living and a significant transition away from the traditional pastoral-rangeland system. Subsequently, livelihood diversification is categorized as an adaptation strategy. Changing herd composition, community rangeland planning, and use of veterinary medicine vaccinations are also categorized as adaptation strategies because they reduce a household’s vulnerability to

current and future drought and require significant proactive investments. Table 4 lists each strategy and the corresponding description and classification.

Table 4. List of coping and adaptation strategies

Coping Strategies	
Strategy name	*Strategy description*
Migration via walking	Walking livestock more than a day's walk away from primary settlement to access pasture
Migration via truck	Moving livestock by truck to access pasture
Supplementary feeding	Buying non-pasture food sources such as vegetable scraps to feed livestock
Buying livestock	Buying livestock to increase herd size
Selling livestock	Selling livestock to reduce herd size
Adaptation Strategies	
Strategy Name	*Strategy description*
Community rangeland planning	Working with community members and/or organizations to determine where and when to graze
Changing herd composition	Changing the species of livestock in herd

Using veterinary medicine	Providing livestock with medicine such as vaccines to prevent illness
Livelihood diversification	Investing resources in non-livestock related livelihoods

Using this list of nine strategies, we created two predictor variables by summing the total number of coping strategies and the total number of adaptation strategies used by each household.

Covariate variables. To isolate the influence of our key predictor variables, we collected household demographic information to later use as controls and for comparisons. We decided on these factors based on previous literature and conversations with our local research team. These variables included:

Gender of head of household (see Achiba, 2018; Opiyo et al., 2014). This categorical variable describes whether the head of household is male or female. This was determined by assessing first if the participant was married, and then, if her husband routinely lived in her home (some women are married, but live separately from their husbands, and thus marital status alone would not necessarily indicate if the participant was a primary day-to-day household decision-maker).

Formal education of all adults in household (see Eneyew & Bekele, 2012). Participants described the composition of their household and provided the years of formal education experience for each member. The number of years for each adult were summed to create a single variable for the entire household.

Household size (see Eneyew & Bekele, 2012; F. E. Opiyo et al., 2014). Defined as the number of people that regularly eat and sleep in the home.

Community. This variable was included based on the expertise of the local research team members, as the adherence to traditional Samburu cultural practices such as gender roles, migration practices, and the access to basic services varies widely in Samburu, and the two communities in this study represent this contrast.

Level of income diversification prior to drought (see Opiyo et al., 2014). Participants were asked to indicate the proportion of their income that came from livestock-related activities prior to the drought (e.g. selling of livestock, selling of milk or hides, etc.). Participants were given 10 rocks and asked to separate the rocks into two groups to represent income that came from livestock versus income that came from non-livestock activities. The number of rocks given to non-livestock related activities was then divided by 10.

Herd size prior to drought (see Dinku, 2018; Opiyo et al., 2014). Participants were asked to indicate the number of shoats, cows and camels their household owned prior to the drought. These numbers were then converted to average market value of each species and summed to create a total livestock value (shoats = 3500 KSH each; cow = 30,000 KSH each, camel = 60,000 KSH each. Note: 100 KSH = ~1 USD).

Data Analysis

To analyze the influence of adaptation versus coping strategies, a series of forced-entry multiple linear regressions were run using R statistical software. A model was conducted for each of the four outcome variables (i.e., livestock loss, food security, ability to provide for children, and hope).

While livestock keeping is a livelihood practiced by a majority of Samburu, some households rely solely on other sources of income and do not own livestock. This was the case for some of the participants in our original sample. Prior to running regression models, we

filtered our original data set (n =200) to remove households who did not have livestock prior to the 2017 drought. We also filtered the data set to remove households which reported a proportion of livestock loss greater than 1 (a number greater than 1 indicates a household loss more than 100% of their livestock, and therefore, likely an overestimate by the participant). This filtered data set resulted in a sample size of n = 165.

After analyzing descriptive statistics and visual representations of all variables, we ran t-tests, Wilcoxon rank sum tests, correlation analysis, and chi-square tests to explore the relationship between each of our variables. We then centered our numerical predictors and covariates at the mean to increase the ease of interpretation of regression coefficients. For each outcome variable we ran the following multiple linear regression model and checked for violations of assumptions.

$$Y = \beta_0 + \beta_1 Adaptation + \beta_2 Coping + \beta_3 Gender + \beta_4 Education + \beta_5 Household\ size + \beta_6 Community + \beta_7 Income\ Diversification + \beta_8 Herd\ Size$$

Food security as an outcome variable was poorly predicted by our model ($R^2 < 0.05$, $p = 0.32$) and it was dropped from further analyses. Distribution of the ability to provide for children variable violated the linear relation assumption. Based on analyses of fitted versus residual plots for individual variables, the results from our preliminary tests (i.e. t-test, Wilcoxon rank sum) and our knowledge of the area, we added the community variable as an interaction with our key predictor variables. We used the equation below to predict the provide for children outcome variable and this alleviated the linear relationship violation.

$$Y = \beta_0 + \beta_1 Adaptation + \beta_2 Coping + \beta_3 Gender + \beta_4 Education + \beta_5 Household\ size + \beta_6 Community + \beta_7 Income\ Diversification + \beta_8 Herd\ Size + \beta_9 Adaptation*Community + \beta_{10} Coping*Community$$

Results

All 165 participants were women and ranged in age from approximately 18 to 75 years. Fifty-one percent (51%, n = 84) of households had a woman as the head of household. The average years of education of the adults in the household was 3.41 (*SD* = 6.37) and the average household size was 5.29 (*SD* = 1.95) Approximately 60% (n = 99) of households were located in community A and the remaining 40% (n = 66) in community B. The average proportion of income that came from non-pastoral activities prior to the drought was 54% (*SD* = 21%), and average herd size was 5.64 (*SD* = 8.8; see Table 5).

Table 5. Descriptive statistics of demographic variables

Variable	*Mean*	*SD*	*Median*	*Min*	*Max*
Years of education of adults in household	3.41	6.37	0.00	0.00	26.00
Years of education of participant	2.02	3.94	0.00	0.00	14.00
Household size	5.29	1.95	5.00	1.00	13.00
Proportion of income from non-pastoral activities	0.54	0.21	0.50	0.00	1.00
Herd size (1 = 1 cow)	5.68	8.08	2.40	0.12	59.20

Age of participants	~18-30 years	~31-45 years	~ 46 + years
	34.55% (n=57)	36.36% (n=60)	29.09% (n=48)

Gender of head of household	Woman	Man
	50.90% (n = 84)	49.09% (n = 81)

Key predictor variables: Adaptation and coping

On average, households used a slightly higher number of adaptation strategies (M = 2.70, SD = 0.94) in comparison to coping strategies (M = 2.42, SD = 1.20) during and following the 2017 drought.

Herd size and income diversification had a significant relationship with the coping variable ($r(163) = 0.20$, $p < .01$; $r(163) = -0.26$, $p <. 01$). Adaptation had a significant correlation with participants' reported ability to provide for their children ($r(163) = 0.17$, $p = 0.03$) as did coping with participants' sense of hope ($r(163) = 0.17$, $p = 0.03$). Table 6 illustrates the results of correlation analyses of key predictor variables and covariate variables that are continuous. Table 7 shows results from t-tests between key predictors variables and categorial covariate variables. Table 8 illustrates the results of correlation analyses investigating relationship between key predictor variables and outcome variables.

Table 6. Relationship between key predictor variables and continuous covariates using correlation analyses

	Number of adaptation strategies used		Number of coping strategies used	
Education capacity of adults	$r(163) = -0.11$	$p = 0.16$	$r(163) = -0.06$	$p = 0.44$
Household size	$r(163) = -0.08$	$p = 0.29$	$r(163) = -0.06$	$p = 0.43$
Level of income diversification	$r(163) = 0.12$	$p = 0.13$	$r(163) = -0.26$	$p < .01$
Herd size	$r(163) = 0.06$	$p = 0.48$	$r(163) = 0.20$	$p < .01$

Table 7. T-test results of number of coping and adaptation variables based on two covariates

	Number of adaptation strategies used		Number of coping strategies used	
Gender of head of household	$t(163)= -0.50$, p = 0.61		$t(163) = -0.86$, p = 0.39	
	$M_{women} = 2.67$	$M_{men} = 2.74$	$M_{women} = 2.35$	$M_{men} = 2.51$
Community	$t(163) = -1.11$, p = 0.27		$t(163) = -1.34$, p = 0.18	
	$M_{comm\ A} = 2.64$	$M_{comm\ B} = 2.80$	$M_{comm\ A} = 2.32$	$M_{comm\ B} = 2.58$

Table 8. Correlations between adaptation and coping strategies and outcome variables

	Number of adaptation strategies used		Number of coping strategies used	
Livestock loss	$r(163) = -0.04$	p = 0.64	$r(163) = -0.07$	p = 0.36
Food security	$r(163)= -0.07$	p = 0.34	$r(163) = -0.01$	p = 0.97
Ability to provide for children	$r(163) = 0.17$	p = 0.03	$r(163) = 0.06$	p = 0.43
Hope	$r(163) = 0.06$	p =0.44	$r(163)= 0.17$	p = 0.03

Regression Analysis

The results of regression analysis indicated the model significantly predicted livestock loss, ability to provide for children, and hope, but not food security (see Table 9). As stated previously, the food security model was dropped from further analysis. Table 10 presents the

regression coefficients and standard errors for each predictor in the model for the remaining three outcome variables.

Livestock loss. The model significantly predicted livestock loss, $R^2 = 0.23$, F (8, 156) = 5.79, $p < 0.01$. Years of education, $b = -0.01$, $t(156) = -3.40$, $p < .01$ and community, $b = -0.25$, $t(165) = -5.41$, $p < .01$. were significant predictors. Neither adaptation or coping were significant predictors of livestock loss.

Ability to provide for children. The model also significantly predicted ability to provide for children, $R^2 = 0.39$, F (154) = 9.91, $p < 0.01$. Community was a significant predictor, $b = -1.04$, $t(154) = -5.75$, $p < .01$, as was the interaction between adaptation and community, $b = 0.73$, $t(154) = 4.96$, $p < .01$. After finding evidence of heteroscedasticity, we calculated robust standard errors, which are included in Table 10. Using the robust standard errors did not change the conclusions of the model, indicating the violation of homoscedasticity did not have a large impact on our model.

Hope. Our model was also able to significantly predict hope scores, $R^2 = 0.22$, F (156) = 5.58, $p < 0.01$. The coping variable was a statistically significant predictor, $b = 0.17$, $t(156) = 3.15$, $p < .05$. Additionally, the gender of the head of household, $b = 0.28$, $t(165) = 2.14$, $p < .01$, and community, $b = -0.64$, $t(156) = -4.17$, $p < .001$, were also statistically significant predictors. After finding evidence of heteroscedasticity, we again calculated robust standard errors, which are included in Table 10. Using the robust standard errors did not change the conclusions of the model, indicating the violation of homoscedasticity did not have a large impact on this model. Figure 8 presents a conceptual model of the results.

Table 9. Model summary statistics for each outcome variable

Outcome variable	R^2	df	F	*p-value*
Livestock loss	0.23	7	5.79	< .01
Food security	0.05	7	1.08	0.32
Ability to provide for children	0.39	7	9.91	< .01
Hope	0.22	7	5.56	< .01

Table 10. Regression coefficients for each outcome variable

	Livestock Loss		Provide for Children		Hope	
Variable	*B*	*SE*	*B*	*SE*	*B*	*SE*
Intercept	0.63***	0.03	4.68***	0.079	4.55***	0.10
Coping	0.00	0.17	0.06	0.060	0.17**	0.05
Adaptation	0.01	0.02	-0.09	0.086	0.01	0.06
Education	-0.01**	0.003	-0.01	0.014	-0.01	0.01
Gender of head of household	0.01	0.04	0.03	0.154	0.28*	0.13

Community	-0.25***	0.05	-1.04***	0.181	-0.64***	0.15
Household size	-0.01	0.01	-0.001	0.034	-0.07 .	0.04
Income diversification	0.19	0.10	-0.11	0.325	0.28	0.27
Herd size	0.000	0.002	-0.01	0.011	-0.01	0.01
Community x Coping			0.03	0.125		
Community x Adaptation			0.73***	0.146		

*** = p < 0.001, ** = p < 0.01, * = p < 0.05

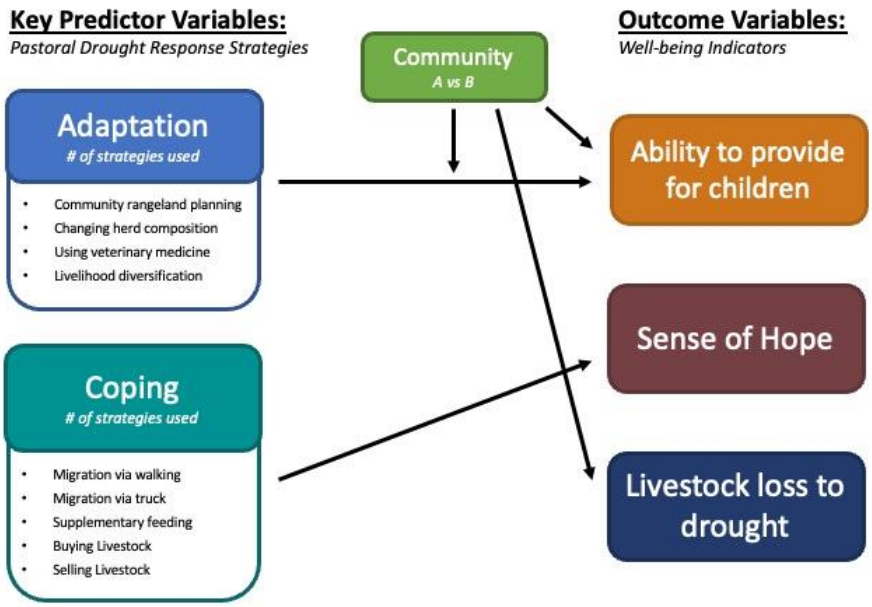

Figure 8. Conceptual diagram of study results

Discussion

Our results indicate that drought response strategies (both coping and adaptation) did not significantly predict livestock loss to drought but did significantly predict specific aspects of well-being following drought. These results point to the importance of using multiple indicators to evaluate the impact of drought and the effectiveness of interventions intended to improve the resilience of communities. Economic measures (i.e. livestock loss) and culturally-specific well-being measures are valuable indicators of drought impact and resilience to such impacts (Béné et al., 2012). However, neither of these measures, when used as alone, tell a complete narrative. On average, households in our sample reported losing 53% of their shoat herds during the drought, indicating a severe drought impact. On the other hand, the well-being data indicated that one and a half years after the drought, participants, on average, could provide for their children and felt

hopeful for the future. By combining these indicators, we get a picture of a community that suffered significantly as a result of the drought and also reported relatively high levels of socio-cognitive well-being 18 months later.

Difference between coping and adaptation strategies

In addition to differences in our model's significance in predicting livestock loss and two aspects of well-being, our results support previous literature's distinction between coping and adaptation strategies (Eriksen & Kelly, 2007; F. Opiyo et al., 2015; Venkatasubramanian & Ramnarain, 2018). The number of adaptation strategies used by a household significantly predicted a woman's ability to provide for her children, but not her hope for the future. Conversely, the number of coping strategies used predicted participant's hope for the future, but not her ability to provide for her children. These results can be explained by the fundamental differences between the two types of strategies and subsequent gendered implications of these differences.

Many of the strategies included in the adaptation category create labour demands largely considered to be within the domain of pastoral women. For example, herd composition changes in response to drought are often characterized by shifts from large-scale livestock such as cattle to smaller scale livestock, such as sheep and goats. Samburu women are more likely to be responsible for small-scale livestock husbandry, and this increase in shoats translates into both an increase in women's labor as well as a potential increase in their decision-making power over livestock (Pickering et al., in preparation). Women are also traditionally responsible for taking care of sick and young livestock; the use of veterinary medicine such as vaccines also typically falls under the domain of women's responsibilities. Additionally, the labour associated with

livelihood diversification often falls on the shoulders of pastoral women (Anbacha & Kjosavik, 2019a; Gurmu, 2018; Karmebäck et al., 2015).

In addition to the impact these adaptation strategies have on women's workload, many of these strategies also have the potential to increase women's decision-making power within their households (Anbacha & Kjosavik, 2019). Previous literature indicates that providing for the basic needs of children is primarily the responsibility of pastoral mothers (Eneyew & Mengistu, 2013; J. Holtzman, 2001; Karmebäck et al., 2015) and our previous research with the community indicates that women consider being able to do so a critical part of their well-being (see manuscript 1). Logically, gains in household decision-making power as a result of drought response adaptations could explain the positive relationship between use of adaptation strategies and women's self-reported ability to provide for their children. A woman may feel as if she has more decision-making power in her household because of her increased responsibility over adaptation strategies, and that decision-making power and sense of agency spills over into other types of decision-making that impact her ability to take care of her children.

However, it is important to note that *adaptation strategie*s were only a significant predictor of *ability to provide for children* when interacting with the *community* variable, indicating the impact of adaptation strategies was larger for participants in community B in comparison to community A. This might be explained by the differences between women living in these two communities. First, women from community B reported significantly lower levels of being able to provide for their children in comparison to community A. Perhaps these lower scores provided more opportunity for the use of adaptation strategies to drive gains in said scores. Another important difference between these communities is the adherence to traditional cultural practices and the associated marginalization of women. As a result, women in

community B might have lower levels of agency and decision-making power, again providing more room for adaptation strategies to increase decision-making power and subsequently, ability to provide for their children. In other words, there may be more room for the pathway in which adaptation strategies increase decision-making power, which increases ability to provide for children for women in community B in comparison to community A. Our results point to the importance of better understanding the role pastoral women's agency and decision-making power play in the relationship between response strategies and women's well-being. Several scholars argue agency plays an important role in increasing adaptive capacity (Cinner et al., 2018; Rao et al., 2020), but the specific mechanisms that drive this relationship require further study.

In addition to the relationship between *adaptation strategies* and a*bility to provide for children* the relationship between *coping strategies* and *hope for the future* can be explained by a fundamental difference between coping and adaptation. Some of the strategies in the coping category (e.g. supplementary feeding, walking livestock) might fall under the domain of women's responsibilities, but many of the coping strategies (e.g. moving by truck, buying and selling) are strategies Samburu men are largely responsible for. As a result, we do not see the same gains in women's ability to provide for their children from the use of *coping strategies* as we do with *adaptation strategies.* The fundamental difference between these two well-being indicators also helps explain the difference in results. In previous work with Samburu women to investigate well-being, participants discussed *hope for the future* in the context of the collective future of Samburu culture and community (see manuscript 1). These same discussions with women about well-being, in addition to previous studies conducted in the region, indicate the practice of pastoralism continues to be critical to Samburu identity, despite significant shifts in

culture (Pickering et al., in preparation). Coping strategies are small, short-term strategies that perhaps encourage optimism about the future viability of pastoralism in a drought-stricken landscape. On the other hand, many of the strategies in the adaptation category require significant, long-term divergences from traditional pastoral practices, and might not encourage the same level of optimism about pastoralism's viability. While *adaptation strategies* might increase women's ability to provide for their children via increases in decision-making power, *coping strategies* may increase participants' level of optimism about the future of their community, culture and pastoral way of life.

Limitations

There are two key limitations to this study that should be noted. First, our study relies on the assumption that measurements of social well-being one and a half years after the drought are a valid indicator of a household's ability to recover from the drought. We do not have measures prior to or directly after the drought to empirically support this assumption. The second key limitation is how we measured the use of adaptation and coping strategies. A high value on either the coping or adaptation variable indicates the use of several different strategies, rather than the intensity or the reliance on a strategy. While it would have been ideal to also include a measure of intensity or frequency of use of each strategy, concerns over participants recall and the diversity of strategies prevented us from doing so. An in-depth focus on the use of each individual strategy and how it may impact well-being is an important area for future research.

Implications for supporting drought resilience of pastoral women

The results of this study point to the importance of using multiple indicators to investigate drought impact and resilience to such impacts. They also support previous literature's distinction between coping and adaptation strategies and highlight the influence of the gendered

division of labor associated with such strategies. From an applied perspective, understanding the gendered nature of the relationship between drought-response strategies and well-being has important implications for supporting pastoral women's resilience to climate change. The results of our study indicate that coping and adaptation responses are distinctively different strategies, with unique impacts on pastoral women's well-being, which can be potentially explained by the gendered divisions of labour. Interventions aimed at supporting the climate resilience and well-being of pastoral women need to consider how gendered divisions of labor might impact the efficacy or subsequent impacts of an intervention that encourages or supports specific response strategies.

Our study also demonstrates the importance of holistically evaluating drought impacts and efficacy of climate resilience interventions. As stand-alone indicators, economic indicators such as livestock loss or socio-cognitive well-being indicators tell very different narratives about the drought resilience of pastoral communities. By only looking at livestock loss numbers, one could determine that neither the coping or adaptation strategies used by Samburu households were effective at mitigating the effects of drought. However, women's self-reported well-being scores indicated that both adaptation and coping strategies had unique and important impacts on their socio-cognitive well-being. These results underscore the importance of a multi-level views perspective; including different types of indicators and measuring them at multiple scales (i.e. household and individual). This has important implications for the design, evaluation, and adaptation of climate change resilience interventions.

Finally, our study also demonstrates the importance of place and community. Our results highlight the vastly different impacts coping and adaptation strategies had on well-being for communities a mere ten kilometers apart. As the international discourse around climate

resilience continues to grow in relevance and urgency, hyper local contexts must be a focal point of the conversation. Geographic and cultural contexts need to play a critical role in the design of such interventions.

CHAPTER 5: CONCLUSION

Implications for theory and literature

Resilience theory is a controversial concept for climate change researchers, particularly for social scientists. Proponents of the concept argue for its ability to push us past solely thinking about climate change impacts to focusing on the process of how systems, and actors within those systems, respond to impacts (Folke et al., 2008; Sellberg et al., 2018). Conversely, opponents posit that resilience is founded in abstract ecological theory and does not tangibly address the complexity and diversity of how human actors respond to disturbances such as climate change (Béné et al., 2012; Davidson, 2010). After spending the last four years thinking about resilience, specifically in the context of the Waso East social-ecological system in Samburu, I find myself simultaneously agreeing with both sides of this argument. Resilience is a helpful lens from which to view the dynamic processes taking place in reaction to climate change. However, the concept of resilience in isolation from other frameworks (e.g. well-being, adaptive capacity) has limited use for thinking about how to actually improve and measure the resilience of systems and human actors within those systems. When I set out to conduct my dissertation research, my goal was to be able to understand and think about resilience in a more tangible and context specific way. The use of concepts and frameworks such as well-being, adaptive capacity, and response strategies are an important step in this direction.

As a single body of work, my dissertation uses tangible and measurable concepts in an attempt to understand the drought resilience process from the perspective of pastoral women. The concept of well-being provides an outcome to measure and an ultimate goal that resilience interventions can be designed to achieve. Response strategies such as coping and adaptations represent tangible ways people react to a changing climate, and these responses either fail or

succeed in maintaining or achieving well-being. Finally, adaptive capacity provides a framework for thinking about the 'levers' that can be pulled to enhance people's ability to engage in effective response strategies. These 'levers', such as education, agency, financial capital, and social capital, all provide opportunities to improve the resilience of individuals and communities.

While these resilience-related concepts are not novel, one of the key contributions of this dissertation is the focus on the interactions within and between these concepts. As scholars, we have a tendency to create frameworks with typologies and dimensions that often appear as mutually exclusive or in isolation from one another. In reality, social constructs are used to explain incredibly complex human behaviour, and these concepts interact with each other all of the time. The WeD framework of well-being (Gough & McGregor, 2007) and its three dimensions have been applied in a variety of contexts in previous literature (Woodhouse et al., 2018; Britton & Coulthard, 2012) with little attention given to how these dimensions may interact with one another. To address this gap, chapter two of this dissertation focuses on the interactions between the three dimensions. In doing so, our analysis of interactions increases the depth of theoretical and contextual understanding of each well-being component (such as financial security, agency, hope, etc.). It also has the potential to strengthen theory of change models, ultimately improving climate resilience intervention effectiveness and highlighting additional pathways for intervention.

Similarly, chapter three uses Cinner et al.'s (2018) theory of adaptive capacity, but rather than focusing on the different domains of adaptive capacity in isolation, we explain the livestock related decision-making patterns by the potential interaction of agency and learning domains, and discuss the potential formal education has for increasing the adaptive capacity for pastoral women. Finally, in chapter four we look at the relationship between two different resilience-

related concepts-- response strategies and well-being -- and explain this relationship by examining how gendered divisions of labour may influence how women experience and engage in coping and adaptation strategies.

While this dissertation makes a valuable contribution to resilience theory and related climate change concepts, I think the most important aspect of this dissertation is that in each of these studies, we center the perspectives of Samburu women. Using a gendered lens to understand climate change impacts and responses is not a novel approach in the literature. However, in the context of pastoral women, the majority of studies use a gendered lens to compare the experience of men and women. While this approach may be credible, by focusing solely on the experiences of Samburu women, our work underscores the stand-alone value of women's experiences and perspective; the beliefs and perceptions of men are not needed to validate or extend value to women. Furthermore, our approach allowed for the necessary time and resources to understand the depth and complexity of Samburu women, how they define a good life, and how they respond to climate change drought impacts.

Moving forward as a researcher

The experience of engaging in this dissertation process has helped me unravel the type of research I want to engage in, and how I want to go about conducting research. As a researcher, my goal is to further our scientific understanding of the relationship between humans and their environments. I seek to use such an understanding to support climate resilience of communities around the world, and humbly recognize the power that research has to be both a platform for marginalized communities and to delegitimize their expertise. The guiding questions that drive my work are: 1) how do communities adapt to changing climates? and 2) what are the social and ecological impacts of these adaptations? I apply social-ecological systems theory and a feminist

political ecology lens to investigate these questions. Concepts such as resilience, adaptation, livelihoods, well-being, and gender are the foundation of my research. I use dimensional theories and culturally-specific, placed-based frameworks to understand these concepts, and prioritize identifying feedback loops and complex interactions between drivers within a system.

Moving forward, I would like to continue to investigate these issues in Samburu as well as other communities both in North America and abroad, with a specific focus on evaluating the social and ecological impacts of climate change resilience interventions. I also aim to continue to investigate how the social identities of specific groups influence their ability to access and experience of impacts of such interventions.

To investigate these issues of social and ecological climate resilience, I prioritize an interdisciplinary and community-based approach to research. I believe strongly in the potential of scientists with varying expertise coming together and transcending disciplinary boundaries. I believe community-based approaches are critical for the practice of cross-cultural research, which means engaging in critical consciousness, relationship-building, reciprocity, and adaptive research processes (see Walker et al., 2020). With respect to methodology, I use a mixed-methods approach, with a focus on participatory and qualitative methods that engage and value participants as experts. My preference for these methods comes from a commitment to investigate and practice ethical cross-cultural research. To fulfill this commitment, I aim to design studies that are based on community needs, provide direct benefits to participants, and provide results that are accessible and useful to stakeholders.

At the core of my work as a scientist are the beliefs that the production of knowledge is a vital component of solving complex problems and the purpose of science, and those who conduct it, is to build a more resilient and equitable world.

Personal reflection

The experience of moving halfway around the world and throwing myself into an entirely different culture undoubtedly forced a significant amount of personal reflection, something I'm sure to which most social-science field researchers can attest. My experience working and living in Archer's Post has impacted nearly every aspect of my life, but for the sake of brevity, I'll focus the scope of my reflection on my role and responsibilities as a Western researcher in a community like Archer's.

When I started my graduate training, I did not intend to end up in the world of international conservation and development. My sights were set on issues closer to home, but the resiliency of the Samburu people and their connection to the landscape grabbed my attention and never let go. Archer's Post is a community consumed by change - with one foot in a traditional pastoralist culture and another in an increasingly globalized world. As community members passionately attempt to hold on to their vibrant culture and well-being, they simultaneously navigate issues of climate change, development, and ecological degradation, just to name a few. At the center of my interest in working in this community is the recognition that Samburu is one of the many regions in the world the climate crisis negatively impacts while the Samburu people are some of the least responsible for these consequences. In addition to curbing our carbon emissions, I believe that Western society has an immense moral responsibility to support communities like Archer's Post as they navigate the challenges associated with the climate crisis. But that leads me to ask: what role should I -- a white, Western, female, early-career researcher -- play in this process? How can I navigate colonial legacies, racial power dynamics, and cultural differences in a way that supports rather than retract from a community's agency, self-determination, and resilience? Is that even possible?

Authors like Dambisa Nayo, Abhijit Banerjee, Esther Duflo, and William Easterly have actively shaped my thinking on these issues. More recently, I have found myself enthralled by the work of feminist theorists writing on topics of gender, race, identity politics, and international development. Authors like Alcoff, Butler, Nussbaum, and Ralston and Keeble have all eloquently illustrated the various perspectives on whether individuals should engage with research and work centred around the experiences of a social group different from their own identity. On one side of the argument, Alcoff highlights the danger of a person with privilege speaking on behalf of another group of people: "Though the speaker may be trying to materially improve the situation of some lesser-privileged group, the effect of her discourse is to reinforce, racist, imperialist conceptions and perhaps also further silence the lesser-privileged group's own ability to speak and be heard" (1991, p. 5). Alcoff is unambiguous in her approach: when privileged researchers attempt to speak on behalf of marginalized groups of people, we tend to do more harm than good. Alternatively, Ralston and Keeble argue that people with privileged identities "can (and sometimes should) speak for others if we are mindful of our own prejudices and understandings; and that we can be useful partners in the creation of change" (2009, p. 11). Ralston and Keeble argue for the responsibility of people with privilege to challenge systems of oppression and that by conducting ethical research, regardless of our identities, we can contribute to social change. These seemingly opposing viewpoints on the role of Westerners in research and development left me at a crossroads. Is conducting research and then attempting to ensure that my work impacts practical change synonymous with 'speaking for' the Samburu people?

I simultaneously agree with both Alcoff and Ralston andKeeble. I agree that there is inherent risk in speaking for any group of people with whom we do not share an identity. However, risky and productive are not mutually exclusive. The conservation and development

fields come from a long and continued history of oppression. Particularly in Kenya, conservation is often dominated by white Westerners making decisions that disproportionately impact the lives of people with wholly different identities. This often serves to reproduce colonial power dynamics based on race, gender ,and class. As an academic in the field of conservation who shares many of the same identities with the leaders in this field, I have a responsibility to challenge the conservation practices and narratives that fail to take into account the diversity and intersectionality of different identities. But I also recognize the inherent risk in my actions; the ease with which I too could simply reinforce these dynamics. The navigation of this multiplicity of truths requires a critical, continuous engagement in reflexivity; an engagement with "analysis paralysis".

I am sure that the multiple authors who coined the term *analysis paralysis,* never intended for it to be thought of as a necessary step in reflexivity. In their book, Reluctant Bedfellows, Ralston and Keeble define analysis paralysis as the "ambivalence in academia about doing something, both theoretically and politically, outside one's own backyard; and a hesitation to speak or act for anyone but (literally) one's own self" (2009). They blame analysis paralysis for the immobilization of feminist activism with respect to academics in international development. They go on to characterize the 'trepidation' that so many academics, particularly graduate students, experience when engaging in cross-cultural research as creating confusion and providing justification to 'do nothing'. However, I think Ralston and Keeble make two critical mistakes in their critique of this debate. First, they discuss *analysis paralysis* as a state of permanence rather than a dynamic dance of which academics and students continuously engage. Second, they characterize this 'hesitation to speak' as counterproductive. I frequently remind myself of what a privilege it is to be creating a career in academia, to have the freedom to follow

my curiosity and critically think about the systems and institutions that construct our realities. This privilege requires me to engage deeply with complex problems and ethical dilemmas before using my platform to tell a particular story of society. As a Western researcher who works with a group of people that hold a different social identity and experience with oppression, I am required to dive deeply into this paralysis and fight to find the other side, only to dive in again.

The notion that foreign researchers can only negatively impact communities or have fantastical potential to create social change is a false dichotomy often created in feminist discourse on international development and research. I have the potential to fulfill both roles simultaneously, and the responsible way to navigate that complexity is to engage continuously and authentically in critical self-inquiry. As a researcher, I have a responsibility to participate in 'engaged scholarship'. I need to seek a state of paralysis out, and then push through, fighting for a better understanding of my own privilege, positionality, and relationality with others. I must adapt my work accordingly and repeatedly engage in this process. In practice, that process includes supporting and highlighting community expertise and ensuring research provides benefits via the results of a study as well as people's very participation in the study. It also includes seeking out and following the guidance of local mentors, and critically judging one's actions and admitting mistakes. Most importantly, it's recognizing that my work understanding and navigating these issues doesn't end with the dissertation process but is rather a lifelong commitment to ethical scientific inquiry.

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